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Fruit culture

v. 1

ESSENTIALS OF FRUIT CULTURE
VARIETIES OF APPLES
APPLE CULTURE
APPLE PESTS AND INJURIES
APPLE HARVESTING, STORING, AND
MARKETING
PEAR CULTURE
CHERRIES, APRICOTS, AND QUINCES

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PREFACE

The International Library of Technology is the outgrowth of a large and increasing demand that has arisen for the Reference Libraries of the International Correspondence Schools on the part of those who are not students of the Schools. As the volumes composing this Library are all printed from the same plates used in printing the Reference Libraries above mentioned, a few words are necessary regarding the scope and purpose of the instruction imparted to the students of—and the class of students taught by—these Schools, in order to afford a clear understanding of their salient and unique features.

The only requirement for admission to any of the courses offered by the International Correspondence Schools, is that the applicant shall be able to read the English language and to write it sufficiently well to make his written answers to the questions asked him intelligible. Each course is complete in itself, and no textbooks are required other than those prepared by the Schools for the particular course selected. The students themselves are from every class, trade, and profession and from every country; they are, almost without exception, busily engaged in some vocation, and can spare but little time for study, and that usually outside of their regular working hours. The information desired is such as can be immediately applied in practice, so that the student may be enabled to exchange his present vocation for a more congenial one, or to rise to a higher level in the one he now pursues. Furthermore, he wishes to obtain a good working knowledge of the subjects treated in the shortest time and in the most direct manner possible.

In meeting these requirements, we have produced a set of books that in many respects, and particularly in the general plan followed, are absolutely unique. In the majority of subjects treated the knowledge of mathematics required is limited to the simplest principles of arithmetic and mensuration, and in no case is any greater knowledge of mathematics needed than the simplest elementary principles of algebra, geometry, and trigonometry, with a thorough, practical acquaintance with the use of the logarithmic table. To effect this result, derivations of rules and formulas are omitted, but thorough and complete instructions are given regarding how, when, and under what circumstances any particular rule, formula, or process should be applied; and whenever possible one or more examples, such as would be likely to arise in actual practice—together with their solutions—are given to illustrate and explain its application.

In preparing these textbooks, it has been our constant endeavor to view the matter from the student's standpoint, and to try and anticipate everything that would cause him trouble. The utmost pains have been taken to avoid and correct any and all ambiguous expressions—both those due to faulty rhetoric and those due to insufficiency of statement or explanation. As the best way to make a statement, explanation, or description clear is to give a picture or a diagram in connection with it, illustrations have been used almost without limit. The illustrations have in all cases been adapted to the requirements of the text, and projections and sections or outline, partially shaded, or full-shaded perspectives have been used, according to which will best produce the desired results. Half-tones have been used rather sparingly, except in those cases where the general effect is desired rather than the actual details.

It is obvious that books prepared along the lines mentioned must not only be clear and concise beyond anything heretofore attempted, but they must also possess unequalled value for reference purposes. They not only give the maximum of information in a minimum space, but this information is so ingeniously arranged and correlated, and the

indexes are so full and complete, that it can at once be made available to the reader. The numerous examples and explanatory remarks, together with the absence of long demonstrations and abstruse mathematical calculations, are of great assistance in helping one to select the proper formula, method, or process and in teaching him how and when it should be used.

In the present volume, the fundamental parts of the subject and the culture of apples, pears, cherries, apricots, and quinces are treated. The factors affecting the fruit industry are discussed, and the many methods of propagation and pruning of fruit plants, of the preparation of fungicides and of poisonous and contact insecticides, and of the handling of spraying machinery are described explicitly. Apples, the most important fruit commercially, are taken up first and treated in great detail. The different systems of planting, the methods of management, including tillage, cover crops, sod culture and mulch culture, pruning, thinning, fertilization, the renovation of old apple orchards, the prevention of injury from low temperatures and from insect pests and diseases, the harvesting, picking, grading, packing, storage, marketing, and the profitable utilization of inferior fruit, are discussed in a clear, comprehensive manner. Pears, cherries, apricots, and quinces receive similar treatment. The different varieties of fruits are handsomely illustrated in colors. This volume, together with the succeeding volume on this subject, forms an eminently practical and up-to-date work on fruit growing.

The method of numbering the pages, cuts, articles, etc. is such that each subject or part, when the subject is divided into two or more parts, is complete in itself; hence, in order to make the index intelligible, it was necessary to give each subject or part a number. This number is placed at the top of each page, on the headline, opposite the page number; and to distinguish it from the page number it is preceded by the printer's section mark (§). Consequently, a reference such as § 16, page 26, will be readily found by looking along the inside edges of the headlines until § 16 is found, and then through § 16 until page 26 is found.

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ESSENTIALS OF FRUIT CULTURE

(PART 1)

INTRODUCTION

1. The growing of high-grade fruit requires special skill and training, as it calls for an intimate acquaintance with and an understanding of the individual fruit-bearing plants. Many of the general agricultural crops, for example, corn, wheat, oats, timothy, and clover, are grown in the mass and are usually observed as fields of plants, not as individual plants. Little attention is given to the isolation of the plants in such crops except to sow a given quantity of seed per acre in order to regulate, in a general way, the number of plants that occupy a given area of ground. And, further, in the growing of grain or grass crops, there is usually no selection of the best plants or weeding out of the poor ones. The seed is sowed, the crops are harvested, stored, and subsequently handled by machinery. Fruit trees, vines, and berry plants, on the contrary, are planted a certain distance apart, and the plants are pruned and managed individually. The nurseryman discards and burns those plants that are not of a given grade or standard; and the manager of an orchard or of a fruit plantation still further carries out the selection of desirable plants by choosing in the nursery the grade of trees that he desires to plant and by discarding, when he comes to planting the trees, those that do not please him. The product of fruit trees is gathered individually and thus the grower has opportunity to observe which plants produce the best grade of fruit and which the inferior grade.

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§ 1

Thus, it is seen that all this experience with individual fruit-producing plants gives the grower a more intimate acquaintance with and an understanding of the activity of fruit-bearing plants than a farmer obtains of the general field crops that he grows.

Another important factor that has contributed to rendering fruit growing a specialized business is the development of special fruit-growing centers. Formerly the fruit consumed in a given region was grown locally, largely because transportation facilities were such that it was impossible to ship fruit over long distances. If a community were to be supplied with fruit, it was necessary that it be grown in the immediate vicinity whether the soil or climate were especially favorable to that fruit or not. Modern methods of transportation and refrigeration, however, enable growers to ship fruit over long distances and to hold it on the market for periods of several weeks, and on account of these changed conditions, it is possible for the fruit grower of the present time to select locations where the soil, climate, and other conditions are especially favorable to the growing of a given kind of fruit.

Each decade the consuming public is demanding a finer product; competition is becoming very keen in an attempt to produce the best; and insects and diseases have spread from former local areas to large general areas throughout most fruit-growing sections. This means that the fruit grower must be awake to methods of preventing injury to the fruit crop by insects and fungous diseases. In fact, to be abreast of the times today, the fruit grower must put forth intelligent effort in every direction.

FACTORS AFFECTING FRUIT GROWING

NATURAL FACTORS

2. In considering the natural factors that affect the growth of fruit plants, it should be borne in mind that a fruit tree, shrub, or vine is a growing, living thing; that it is a plastic, shapable, living organism; and that it is modified by every influence of its surroundings. The pruning, cultivating, spraying, or other treatment given to a fruit plant makes it different from what it otherwise would have been, and whenever anything is done to a tree or a plant, it does something in return as a result. For this reason, to understand fruit culture, the grower must consider very carefully every phase of the environment in which a plant lives, for every change either favors or opposes its development.

3. Influence of Temperature.—Of all the natural factors affecting the growth of fruit plants, temperature is the most important. Temperature very largely determines the area over which a given species of fruit plants can be successfully grown. Toward the north a limit is reached beyond which only the hardiest species of fruit survive, and a little farther north even these cannot endure the winter cold. On the other hand, temperature just as definitely sets a southern limit beyond which a given species does not flourish. The apple, pear, and plum, for example, thrive generally throughout the larger part of the United States. The peach cannot withstand so low a temperature and, therefore, unless influenced by modifying conditions, the northern limit of successful peach culture is somewhat farther south than that of the previously mentioned fruits. The citrus fruits thrive only adjacent to the semi-tropical districts, such as are found in Florida and California.

It is important for a fruit grower, in determining the location of a plantation or orchard, to know something of the limits of

temperature which the species of fruit that is to be planted will endure, and also to know that varieties of each species differ in their climatic adaptations. For instance, some varieties of apples reach their best development toward the northern portions of the United States; other varieties, needing a slightly warmer temperature, find their most congenial place in the southern half of the country. Usually, a given variety reaches its best development within comparatively narrow limits of temperature, and certain varieties suited to one extreme of climate are usually correspondingly unsuited to the other extreme. Wherever winter temperatures fall too low or summer temperatures rise too high for the best development of a given variety, that variety should not be grown.

4. Influence of Altitude.—The altitude of land also has an effect on the growth of fruit plants. The greater the altitude at any latitude the lower will be the temperature, and plant growth will be affected the same as by a more northern latitude. The effect of an increase in altitude on the growth of vegetation may be observed by ascending a mountainside. At the base of the mountain will be found trees that are common for that latitude, but as a higher altitude is reached low, dwarfed, and scrubby specimens of this same species of trees occur, and a little farther up the slope this species disappears altogether and another species is found. It is clear, therefore, that the limit of altitude beyond which a given variety of fruit will not thrive cannot be definitely given. As a general rule, a high altitude in a southern latitude is very similar in regard to temperature as a much lower altitude at a more northern latitude. At extremely high altitudes in any latitude the climate is too cold and bleak for most fruits to thrive.

A study of elevations, however, is of great importance to the fruit grower. One of the most important things to be considered in connection with elevation is atmospheric drainage, that is, the drainage, or passage, of air over the surface of an area. During the growing season, the atmosphere at the surface of the earth is cooled rapidly at night. Cold air, being heavier than warm air, settles to the earth, flows into low

places, down slopes into ravines and valleys and over water courses. This draining away of air is just as real as the draining away of water from areas of land, but unlike water drainage, the air removed is immediately replaced by other air. Air drainage is much less generally understood, however, than water drainage, because air drainage is not visible like water drainage. A practical conception of air drainage may be gained by walking over an area of uneven ground on a summer night. On the higher elevations the atmosphere is usually warm, but in the ravines a stream of cold air is encountered which is flowing off from higher elevations. On passing up the opposite side of the same ravine, the observer can feel his head rise above the layer of cold air. Wherever such a condition occurs, the area into which the cold air settles is generally frosty and unsafe for fruit growing. The first frosts of autumn most often occur in ravines and low places, and it is in such places that tender plants are first killed; the same varieties often remain unharmed on higher elevations in the same general locality.

The depth of cold, frosty atmosphere that will collect in low places depends on the area of the country drained, the area over which the cold air collects, and the position and size of outlets, just as definitely as the size of streams, ponds, and lakes depends on the territory that they drain and the location and size of their outlets.

5. Provided there is still lower land in the adjacent valley into which the cold air may drain, fruit trees or plants may often be planted with safety well toward the base of a slope. The wider the low valley, the more the cold air can spread out and the less likelihood of its rising upwards on the adjacent slope. A low place or a basin that has no outlet is usually a dangerous place for fruit, as the cold air cannot flow away. A concrete example of the need of atmospheric drainage will serve to illustrate the above point. A long, gentle slope was cleared for a peach orchard. Toward the lower edge of this slope a dense forest with luxuriant vines and undergrowth was left standing. When the peach orchard came into bearing age,

the lower one-fourth of it adjacent to the standing forest in the valley had the blossoms killed in two successive springs by late frosts. This frosted area at its upper border formed almost a perfect contour line of given elevation. At its higher edge some of the trees had the fruit buds killed on their lower limbs, and those toward the top of the trees escaped injury. Apparently the cold air at night, flowing down the slope, failed to flow off readily through the standing forest; the latter, with its tangle of vines and undergrowth, formed a dam that held a pocket of cold, frosty air in the lower portion of the orchard. Finally, this adjacent woodland was cut down, thus making it possible for the air to flow into the valley at the bottom of the slope. As a result, the frost line was lowered and in subsequent springs the entire peach orchard escaped injury from frost.

If it is found necessary to utilize low-lying areas for fruit culture, late-blooming varieties should be planted, as they are less liable than early varieties to be injured by spring frosts.

6. Influence of Bodies of Water.—The presence of a large or a very deep body of water tempers the atmospheric conditions of the surrounding region, and for this reason has a very pronounced influence on its fruit-growing interests. Especially is this true if the fruit trees or plants are grown on that side of the water toward which the prevailing winds blow after passing over the body of water. The reason for this influence is that a body of water absorbs very slowly a large quantity of heat during warm weather and gives up this heat just as slowly during cold weather. Among the many regions so affected by bodies of water may be mentioned a strip of land along the west side of the southern peninsula of Michigan overlooking the east shore of Lake Michigan. The effects of this lake are felt at various points for a distance of from 3 to 20 miles inland, the width of the favored fruit area depending on the lay of the land. Where the land adjoining the lake arises somewhat abruptly to a good height, its influence does not extend inland much beyond the top of the adjacent hills; but where the land rises gradually, thus making a wide slope facing the lake, the influence extends inland over the

entire slope. It is interesting to contrast conditions on the west side of this southern peninsula with those on the east side adjacent to Lake Huron. Cold winds, which come mostly from the west and the northwest, are devastating in their effect on the western side of Lake Michigan; in passing over this large body of water, which does not usually freeze over in winter, the winds are so tempered that their effect on the fruit trees on the eastern side of the lake, along the western side of the peninsula, is not damaging; in passing over the peninsula, the winds again become very cold and as a result are damaging to the trees on the eastern side of the peninsula, adjacent to Lake Huron.

As a result of the tempering effect of Lake Michigan, the peach can be grown safely even as far north as the Grand Traverse Bay district, on the eastern shore of Lake Michigan, but it cannot be grown with any degree of safety at that latitude in the eastern part of the state. A section in the southern part of Ontario adjacent to the Great Lakes is affected much the same as is the western part of the southern peninsula of Michigan. Peaches and other tender fruits can be grown much farther north in this section than they can with safety in any of the distinctly inland sections of Canada.

Fruit trees growing on the bluffs overlooking the Mississippi and Missouri rivers in the central part of the United States frequently are not injured by severe winters, but the same varieties of trees growing a few miles inland from the river bluffs have their fruit buds killed. Even small inland lakes, especially if they are deep, may produce a pronounced local effect in tempering the climate of the surrounding slopes. This tempering effect on the climate has a tendency to prevent early autumn frosts and to retard the development of fruit buds in the spring so that they do not open sufficiently to be damaged by late spring frosts.

7. Influence of Winds.—A certain degree of atmospheric circulation is desirable for fruit plantations, because frosts are less liable to occur where the air is in motion than where it is still. Most fruit-producing plants are not often seriously

injured by moderate winds, but may be badly injured by severe winds. In regions subject to strong prevailing winds or in sections where wind storms are common much immature fruit is blown off the trees. The trees tend to lean or tip in a direction opposite to that from which the prevailing wind comes; the branches of the trees have a more spreading, branching top on the leeward side of the tree than on the windward side; and it is not uncommon for cold, dry winds of winter to cause evaporation of moisture from the twigs and branches of the trees to such an extent that they suffer from winter killing, or killing back, purely as a result of the drying-out process, and in some unprotected sections there is danger of the fruit trees being more or less uprooted by the wind.

To prevent loss of fruit and injury to trees in exposed sections, some orchardists advocate the planting of a row or several rows of trees on the windward side of the orchard to act as a *wind-break*. Some of the advantages of such windbreaks are that they lessen the quantity of windfalls; prevent the whipping and breaking of branches, especially while they are frozen; the rubbing off of fruit buds; and the lopsided growth of trees. Some of the arguments against the use of windbreaks are that the roots of the windbreak trees encroach on the outer row of fruit trees and absorb plant-food and moisture from the soil; that the trees occupy land that might be used for other purposes; that they sometimes prevent cold air from being drawn off, thus causing frost pockets on the leeward side as well as on the windward side of the windbreak; and that they often harbor insect and fungous pests.

In the bleak districts of the United States, especially those districts adjacent to the prairie regions, where windbreaks might seem to be needed if they are needed anywhere, perhaps a majority of the fruit growers are of the opinion that wind-breaks are not necessary, provided certain methods of orchard management are practiced. Some of the methods recommended are as follows: (1) The trees may be headed low so that the wind will cause less bending and shaking of the trees and fewer windfalls than if they are headed high. (2) They may have somewhat denser heads in sections where the

atmosphere is much in motion than in more quiet localities, because trees with low heads with many branches seem better adapted to resisting wind than tall trees having a straight central trunk, or leader. (3) Some notably successful orchardists claim that, regardless of other methods of avoiding the effects of winds, a few more rows of fruit trees planted around the windward side of the orchard are more profitable than are forest trees planted as windbreaks. If this plan is followed, trees on the windward side of the orchard should be planted so that the rows of trees are not continuous across the orchard; that is, two or more systems of planting, as explained in another Section, should be employed.

8. Suitability of Soil.—Fruit is grown on a great variety of soils, varying from a light, sandy loam to a heavy clay. The soil of some of the important fruit-growing districts is very sandy, such as exists in the peach-growing district of the lower peninsula of Michigan; the soils of many of the fruit-growing regions in New England, New York, and Pennsylvania are rocky, gravelly clays or clay loams; and on the bluffs along the Mississippi and Missouri rivers the soil is a loose, fine, rich, mellow loam.

Although soils of varying physical condition may be well adapted to fruit growing, experience has demonstrated the fact that, for fruit-growing purposes, they must be well drained. A porous soil not only affords sufficient drainage for the rapid development of the roots of fruit plants but it enables the roots of the perennial plants to reach down and anchor themselves at a good depth. Fruit trees usually succeed in a soil in which they can take deep root, but they often fail to thrive in soils in which their root system is confined to a shallow soil.

The character of the subsoil is as important as the character of the surface soil; in many places fruit trees thrive well in very inferior, thin surface soil, provided the subsoil is sufficiently mellow and deep to admit of the development of a good root system.

In fertility, fruit soils vary from those that will not produce general farm crops abundantly without a liberal addition of

fertilizer to those that are naturally rich enough to support for decades continued cropping to general farm crops. It has been determined by authoritative investigations that a mature apple orchard in full bearing removes, in its leaves, new wood growth, and crop of fruit, a larger quantity of plant-food from the soil than is used in the production of a crop of corn or of wheat. Inasmuch as only the richest soil will bear cropping for several successive years to corn or wheat without liberal applications of fertilizers, it would seem that fruit crops could not be produced on the same soil year after year without a similar resort to keep up the fertility of the land. As a matter of fact, many orchards located on comparatively poor soil have yielded without being fertilized abundant crops of fruit throughout the life of the orchard; on the other hand, liberal applications of fertilizer to soils of moderate fertility have not increased the yield from mature bearing orchards sufficiently to pay the expense.

It seems safe to believe, therefore, that an orchard located on soil of medium fertility will produce without fertilization abundant crops from the time the trees begin bearing until they die; but distinctly poor soil should receive applications of fertilizer, although the actual fertility of the soil is of minor importance as compared with its physical character.

MARKET FACTORS

9. Location in Respect to Population.—In selecting a location for a fruit plantation, a fruit grower should consider the proximity of the location to centers of population. First of all, a large center of population furnishes consumers and insures a ready market for a large quantity of fruit. Growers that are able to place their fruit in prime condition on the large markets are sure of a ready sale. However, it is necessary, if the fruit is to be marketed at a profit, that it be placed on the market at a reasonably low cost of production, transportation, etc. It is important that abundant labor should be secured for picking, packing, and preparing the fruit crop for market. Ordinarily, such labor is readily available in large

centers of population. Formerly, when fruit was marketed locally, large fruit plantations were practically out of the question, except where much additional labor could be secured at the time of harvesting. In recent years, however, in certain isolated sections, itinerant labor may be secured for handling the crop at the ripening period. For instance, pickers and packers in large groups frequently traverse the country from south to north, following the ripening of the strawberry crop, or the peach crop, or both. For example, as the strawberry crop begins to ripen in Texas, pickers and packers are available who camp adjacent to the plantations and harvest the crop. As the southern strawberries are harvested, these same people move northwards through Arkansas and Missouri and camp in the various strawberry districts until the late strawberry crops of the north have been put on the market. Peaches are harvested and handled in a similar manner and often by the same crew that picked the strawberry crop. The grower who lives on the line of migration of such a body of fruit pickers and packers may readily handle his crop, even though it is grown at considerable distance from a center of population.

10. Shipping Facilities.—Formerly, the fruit supply of the country was, for the most part, grown adjacent to the district in which it was consumed. Even the less perishable fruits like apples were rarely shipped any considerable distance. There might be an excess of fruit in one section of the country and a dearth of it in another section, but a lack of proper facilities for shipping prevented proper distribution and the surplus of the one district was not available to meet the needs of another district. In recent decades improved methods of packing, cooling, shipping, refrigeration, etc., have rendered it possible to distribute fruit over large areas. It is possible, therefore, to grow fruit profitably a long distance from market, provided shipping facilities are good, and growers are enabled to select locations where soil or climatic conditions particularly favor the growing of a given kind or variety of fruit. As a result, special fruit-growing centers are developing almost regardless of their proximity to large markets. For example,

certain areas in the western part of the United States are famous for their fruit, which is shipped to the eastern markets; early strawberries produced in the Gulf States are shipped to the northern centers of population; and the citrus fruits of California reach the eastern markets and those of Florida are sent practically to any part of the United States and Canada.

Although it is possible to transport firm fruit over long distances, and even perishable fruits over distances which the grower, 20 years ago, did not even contemplate could become possible, at the same time adequate transportation facilities should be considered in the selection of a fruit plantation. Transportation to exceedingly distant markets is expensive and should be balanced either by cheap land or by soil and climatic conditions that are exceptionally favorable to the production of fruit. A grower should be near a shipping point because it is highly important that he avoid, as far as possible, long hauls of fruit over bad country roads. Every mile traveled on a bad country road, especially with perishable fruits, adds greatly to the injury of the fruit by bruising. In fact, it is more important to be near a shipping point than it is to be near the market where perishable fruit is consumed. The strawberry growers of the central part of the United States who are located from $\frac{1}{2}$ to 1 mile from their shipping station may be better able to deliver berries in good condition to eastern markets than are the growers who live 5 miles from the markets but on a bad country road. Peach growers realize that it injures peaches more to draw them 2 miles over a rough country road than to ship them hundreds of miles by railroad. This is one of the reasons that fruit-growing interests group about definite centers or shipping points.

PROPAGATION OF FRUIT PLANTS

NATURAL PROPAGATION

11. Increasing the number of plants of any species is known as **propagation**. Plants propagate naturally in two distinct ways; namely, by *seeds* and by *plant division*, and from these natural methods certain artificial methods of propagation have been developed and are now commonly practiced in fruit culture.

12. **Propagation by Seeds.**—All varieties of fruit plants originally produced seed and the majority do so at the present time, but as the seed in most cases is produced by the union of elements from flowers of two plants, the new plant will have some of the characters of both parent plants and may resemble neither of them very closely. For example, a flower on a Northern Spy apple tree growing in an orchard will very probably receive pollen from a tree other than a Northern Spy; if the seeds from the fruit produced by this flower are planted they will produce trees that will probably have some of the characters of the Northern Spy and some of the characters of the tree from which the pollen came; and it will be impossible to know in advance what the fruit will be like. For this reason fruit plants are not usually grown from the seed except for experimental purposes; propagation by division in one of its various forms is generally employed for propagating fruits.

13. **Propagation by Division.**—Certain plants have the habit of reproducing by offshoots from the parent plant, which is known as **propagation by division**. Many of the fruit plants propagate naturally in this way. For example, the red raspberry produces an underground stem, known as a **root stock**, which extends some distance from the original plant; roots and sprouts are formed at intervals along the stem, pro-

ducing new plants; the strawberry sends out on the surface of the ground long trailing branches known as **runners** that take root at intervals and form new plants; and the black raspberry produces long, drooping canes, which take root when the tips touch the ground and are then called **stolons**. As soon as offshoots sent out in this way have become rooted they may be separated from the parent plant and transplanted. A plant produced by any method of division, being simply a part of the original plant, has the characters and produces the same kind of fruit as the parent plant.

ARTIFICIAL PROPAGATION

PROPAGATION BY CUTTINGS

14. A detached portion of a plant containing a growing point or bud placed in soil or water for the purpose of producing a new plant is called a **cutting**. The fruit plants most commonly propagated by the use of cuttings are the grape, the currant, the gooseberry, and the cranberry. Cuttings, so far as fruit propagation is concerned, may be divided into two classes; *hardwood cuttings* and *root cuttings*.

15. Hardwood Cuttings.—The majority of fruit-plant cuttings belong to the class of **hardwood cuttings**, which are cuttings from the ripened wood of a deciduous plant of the present or previous season's growth. The common kinds of **hardwood cuttings** are *simple cuttings*, *heel cuttings*, *mallet cuttings*, and *single-eye cuttings*. These are shown respectively in Fig. 1 (a), (b), (c), and (d).

A **simple cutting** is the most common form of **hardwood cutting** and consists of a straight part of a shoot or cane containing two or more buds. A simple cutting is usually cut off at the lower end just below a bud, because at this point roots will develop most readily; at the top it is cut off some distance above a bud.

A **heel cutting** consists of the lower part of a branch containing two or more buds and is cut off in such a way that a

small part of the parent branch remains on the cutting, forming what is known as the heel.

A **mallet cutting** is produced by cutting through the parent branch above and below a shoot containing two or more buds, leaving a section of the parent branch at the base of the cutting. An advantage in the use of heel and of mallet cuttings is a somewhat greater certainty of developing roots. There is, however, one disadvantage, which is that only one cutting can be made from each lateral branch.

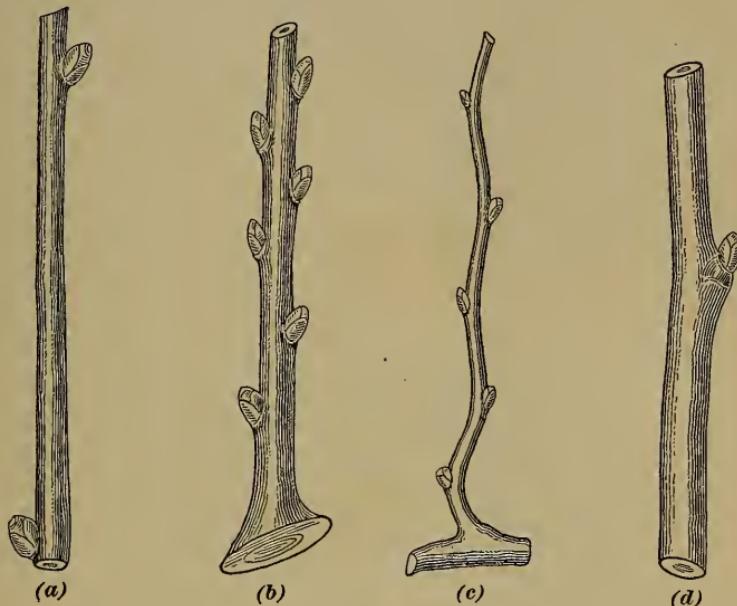


FIG. 1

A **single-eye cutting** consists of a small part of a branch containing only one bud. Such cuttings are sometimes made when it is necessary to get the largest number of cuttings possible from a limited supply of stock. Single-eye cuttings are commonly started under glass either in a greenhouse or in a hotbed where bottom heat can be supplied, and the cuttings are placed in the ground at such a depth that the bud will be about an inch below the surface of the soil, which must be kept moist.

16. Hardwood cuttings should be made during the fall or early winter while the wood is dormant. As fast as made they should be tied in bundles of from twenty-five to fifty, with the butts all one way, and the bundles should be buried in a trench with the butts up and be covered with 2 or 3 inches of soil or sand. The top buds are thus protected from freezing and the butts are near the surface where the sun will warm

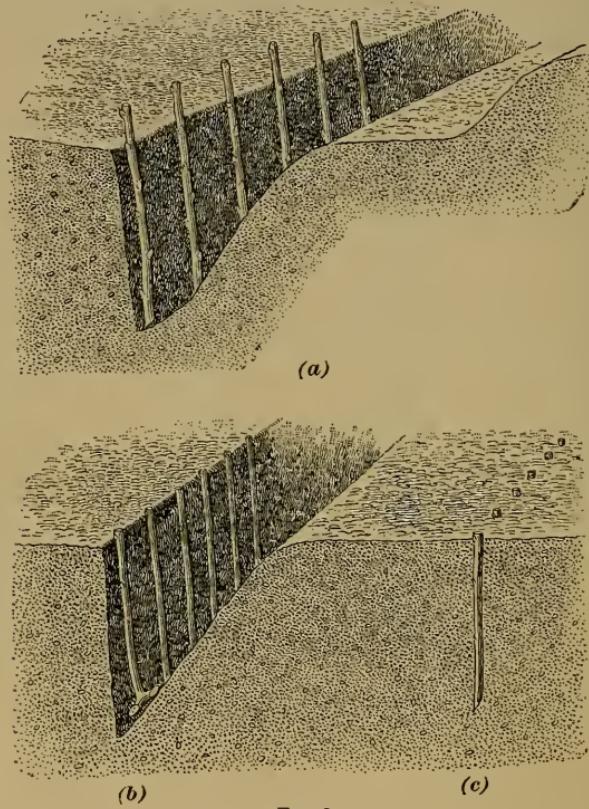


FIG. 2

them in the spring and stimulate root growth. Cuttings may be buried in sand, sawdust, or moss and kept over winter in a cool cellar. In the spring the bundles are taken up and placed in a trench dug as shown in Fig. 2. They are set about 3 inches apart, with only the topmost bud or buds above the surface of the ground, and the soil is then replaced in the trench and thoroughly packed. In Fig. 2 (a) are shown simple cuttings

and in (b) mallet cuttings set in place in a trench; in (c) is shown the position of the cuttings after the soil is replaced in the trench. During the summer the cuttings, if all conditions have been favorable, develop roots and leaves, and in the fall or the following spring are ready to be transplanted to a permanent location.

17. Root Cuttings.—Cuttings made from either roots or root stocks are called root cuttings. Roots as large as a lead pencil or larger are ordinarily selected, although cuttings from smaller roots will grow. Of the fruit plants, blackberries and some of the raspberries are frequently propagated by root cuttings. The cuttings should be made from 2 to 4 inches in length. They are cut in the autumn after the leaves have fallen and before severe frost, and are stored in moss in a cool place until spring. In the spring they are planted horizontally about 2 inches apart in a well-prepared bed and covered with about 3 inches of well pulverized soil. One summer's growth will produce good plants for setting out.

PROPAGATION BY LAYERING

18. Placing a branch in contact with the earth in such a manner as to cause it to throw out roots and shoots while it is



FIG. 3

still attached to and nourished by the parent plant is called layering, and the branch so placed is called a *layer*. There are

several methods of layering, which differ simply in matters of



FIG. 4

detail adapted to the nature of the plant to be propagated.



FIG. 5

A form known as **tip layering** is illustrated in Fig. 3. A branch, or cane, is bent down to the ground and the tip covered with soil. Roots and sprouts will then be thrown out forming young plants, which may be separated from the parent plant. The black raspberry is an example of a fruit plant that may be propagated in this way.

What is known as **vine layering** is shown in Fig. 4. A vine is bent to the ground and

covered with earth in such a way as to leave a small part exposed at intervals. Sprouts will form on the exposed parts and roots on the covered parts. After the young sprouts are thoroughly rooted they may be separated from each other and from the parent plant. In some cases the vine is buried throughout its entire length in a shallow trench. Grapes are often propagated in this way.

Branch layering is shown in Fig. 5. In this case a suitable branch is bent over and a portion near the outer end buried in the earth and fastened with a forked pin; the outer end of the branch is then bent to an upright position and fastened to a stake. A notch or ring is often cut in the bark where the branch is under the surface of the ground. This seems to encourage the production of roots. Apple trees have been propagated in this way.

A method known as

mound layering is often used for the propagation of plants that **stool**—that is, send up many stems or shoots from a single root. This method of layering is illustrated in Fig. 6. The soil is mounded up to cover the base of the stems, which throw out roots as shown in (a); when roots have formed the stems may be removed from the original plant and set out in a permanent location. A plant is often cut back close to the

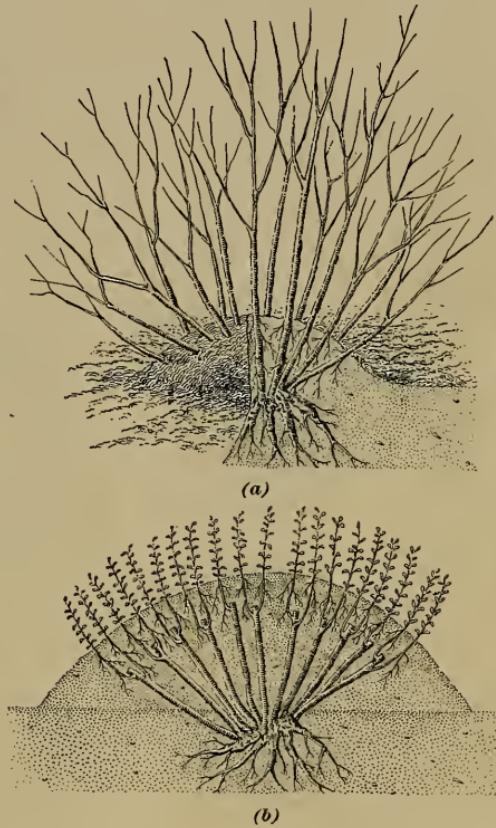


FIG. 6

ground the season before it is to be mound layered to cause it to send up a large number of shoots, as shown in (b).

The soil used in layering should be fertile and moist. Plants are most often layered in the spring; by the following spring, or in some cases by midsummer of the same year, they are ready to be transplanted.

PROPAGATION BY GRAFTING

19. A method of propagation commonly used for many of the tree fruits is known as **grafting**. It is the causing of a twig, called a **scion**, cut from one plant to become part of another. The plant to which the scion is joined is called the **stock**. The different kinds of grafting may be classified, in

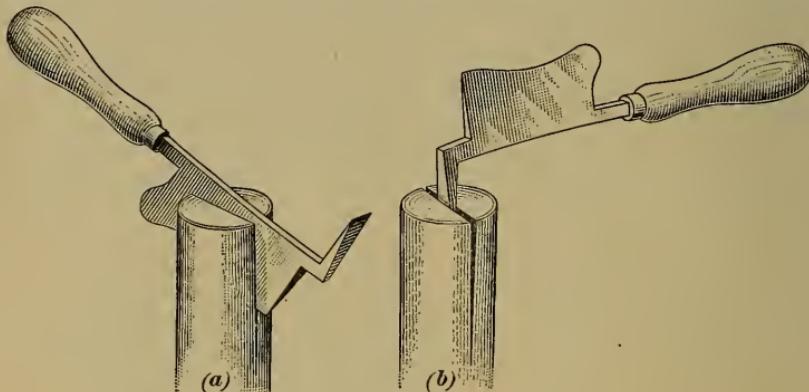


FIG. 7

respect to the place where the scion is attached to the stock, as *root grafting*, or the insertion of the scion on the root of the stock; *crown grafting*, or the insertion of the scion in the stock at the surface of the ground; *stem grafting*, or the insertion of the scion in any part of the main stem or trunk; and *top grafting*, or the insertion of the scion in the top or branches. Grafting is also classified, in respect to the way in which the union between the scion and the stock is made, as *cleft grafting*, *kerf grafting*, *bark grafting*, *whip grafting*, *splice grafting*, and *veeeneer grafting*.

20. Cleft Grafting.—The method commonly used for renewing the tops of mature trees is known as **cleft grafting**.

A branch is severed with a saw, care being taken not to loosen the bark from any part of the stub; the exposed end is then split with a broad, thin chisel or with a grafting tool such as shown in Fig. 7 (a), and the cleft is spread as illustrated in (b) with a wedge or the wedge-shaped prong on the grafting tool so that the scion may be inserted. Scions should contain two or three buds and should be of the previous season's growth. They should be cut during the late fall or early winter and stored in a cellar or other cool place where they will be perfectly dormant. The grafting is done in the early spring before the buds start. The scion is cut to a wedge shape at the butt end as shown in Fig. 8 (a), one edge of the wedge being thicker than the other, and is set into the stock with the thickest edge of the wedge to the outside; this will hold the scion firmly in place and the greatest pressure will come at the outer edges, where growth takes place. The lowest bud on the scion should be just above the upper edge of the wedge so that it will come close to the top of the stock, when the scion is inserted. In order to have growth

there must be contact between the growing tissue of the scion and of the stock so that there may be an interchange of sap between the two parts. The growing part of a stem is the outer part of the wood just underneath the bark. In order to be sure that the growing tissues come in contact, the scion is sometimes set at a slight angle so that the growing wood of the scion must cross that of the stock at some point.

In making a cleft graft, two scions are set in one stock, one at each edge of the cleft, as shown in Fig. 8 (b). If both scions grow, the least desirable one may be cut off. To complete the graft all cut surfaces are covered with grafting wax, as shown in (c); this is pressed closely on to the surfaces so that on cooling it will form a covering impervious to air and moisture.

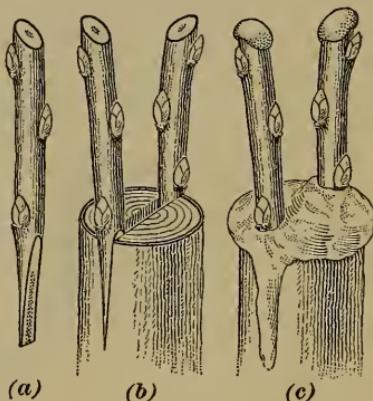


FIG. 8

Good grafting wax can be made of the following ingredients: Resin, 4 pounds; beeswax, 2 pounds; tallow or linseed oil, 1 pound. If it is desired to have the wax of a greater hardness than will result from this formula, the resin may be increased to 5 pounds and the beeswax to $2\frac{1}{2}$ pounds. The resin and beeswax should be broken into small pieces and melted with the tallow or in the linseed oil. When thoroughly melted, the liquid should be poured into cold water, and when cool enough



FIG. 9

to handle should be pulled and worked until it is light-colored and grained. The hands should be well greased before the wax is handled. In applying the wax, the heat of the hand is sufficient to soften it; it may be melted and applied with a brush, but care in this case is necessary to avoid getting the wax heated enough to cause injury

21. Formerly, much emphasis was placed by orchardists on the idea that only branches not exceeding $1\frac{1}{2}$ inches in

diameter should be cleft grafted. This may have been due to the supposition that the young scion could not, in growing, completely cover over the end of a large stock. However, a number of successful orchardists at the present time claim that scions may be grafted with excellent results on stocks up



FIG. 10

to 6 inches in diameter. Fig. 9 shows an old tree top worked by the usual method of cleft grafting. As seen from the illustration, this method of renewing an old tree requires a large number of scions, and in order to secure stocks not over $1\frac{1}{2}$ inches in diameter the branches must be cut off at a consid-

erable distance from the ground. This leaves opportunity for a large number of small lateral branches below the graft. These must be pruned off after the scions start or the tree will bear some of its own fruit. This method of top working large trees necessarily produces high tops, which is a disadvantage in spraying and in gathering the fruit.

Fig. 10 illustrates a large tree top worked by cutting off large limbs, leaving stubs 5 or 6 inches in diameter in which the scions are set. One limb is left uncut to furnish foliage for nourishing the roots. When the scions are well started

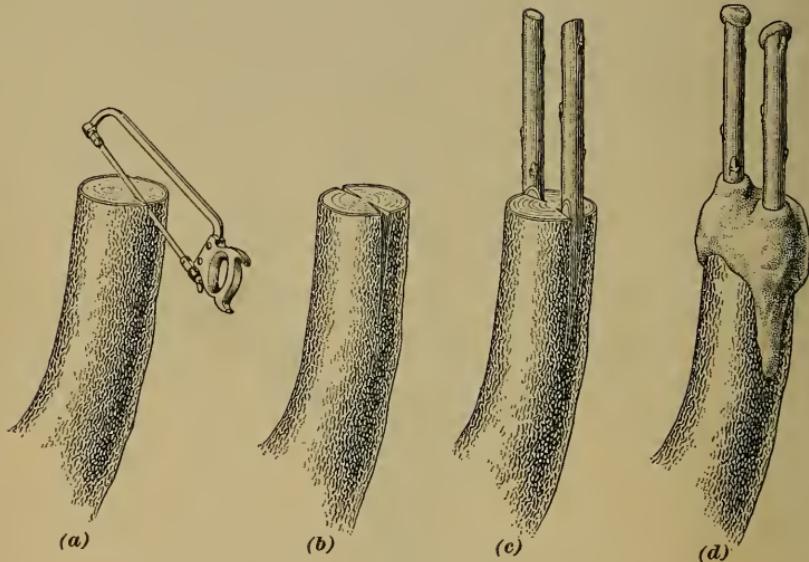


FIG. 11

this limb should be cut off and the stock grafted if desired. This method of top-grafting large trees has the advantage of producing a lower tree than can be produced by the preceding method mentioned, and the entire top will be of the desired variety, as all water sprouts that spring from the branches below the graft may be easily reached and removed. Orchardists who have used this method of top renewal claim that scions grafted on stocks from 5 to 6 inches in diameter are just as likely to live as those grafted on small stocks and will have a much more rapid growth.

22. Kerf Grafting.—In connection with the grafting of large stocks, a method of setting the scion that has been used successfully in Europe for many years and is known as **kerf grafting**, has been introduced into America. By this method, the stock is not split, but a kerf, or notch, as long as the part of the scions to be inserted is cut with a pruning saw as illustrated in Fig. 11 (a); the edges of the notch are then carefully smoothed with a sharp knife as shown in (b). The scion is cut to fit the notch and is driven into place as shown in (c); the cut surfaces are then covered with grafting wax as illustrated in (d). It is claimed as an advantage of this method of grafting over the cleft method that the wound will heal over more quickly and that the probability of growth is just as great as in the case of the ordinary cleft graft. A disadvantage of this method is that the scion is not held so firmly by the notch as it is by the cleft. However, orchardists who have tried this method seem to prefer it to the ordinary cleft method.

23. Bark Grafting.—A method of grafting that does not injure the stock so much as cleft grafting is illustrated in Fig. 12. This method is known in America as **bark grafting** and in England and France as **crown grafting**. The lower ends of the scions are cut to a very thin wedge and are inserted between the bark and the wood of the stock after the branch has been cut off as for the cleft graft. After the scions have been inserted the bark is securely bound with raffia or waxed string and grafting wax is used as in the cleft graft.

The raffia used in binding many forms of grafts is a product of an oriental palm and may be purchased at a very reasonable price. It is customary to lay the raffia on the ground or in some other damp place over night before using, in order to soften it so that the operator may flatten out the strands, which should be cut to the desired length before the work of wrapping begins. After 2 or 3 weeks the raffia bands are cut, so that they will not interfere with the



FIG. 12

growth of the stock. Waxed string is prepared by putting a ball of No. 18 knitting cotton into a kettle of melted grafting wax. In 5 minutes it will be thoroughly saturated and may be kept indefinitely. When waxed string is used for binding it is not often necessary to cut the bands, as the string will soon decay and will not interfere with the growth of the stock.

24. Whip Grafting.—The method almost universally used for root grafting and occasionally used for grafting small limbs is known as the **whip grafting**. This method of grafting has an advantage in that it can be used on very young stocks—those only 1 or 2 years old. In making a whip

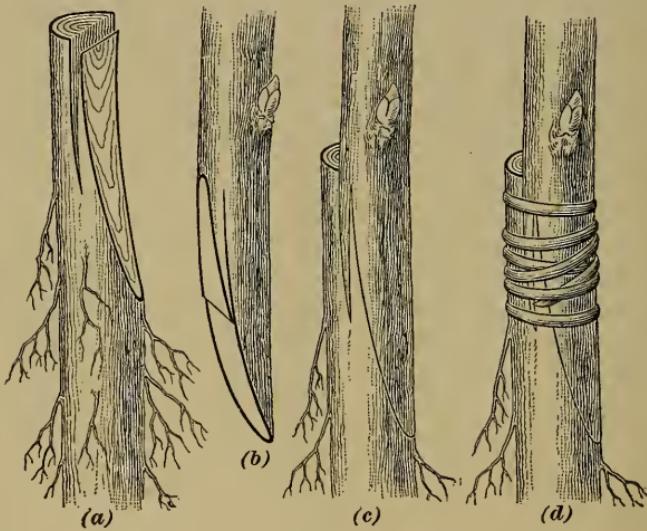


FIG. 13

graft, one long, smooth, slanting cut is made at the top of the stock with a sharp knife. The knife is then placed on the cut surface near the top and the stock is split in the direction of its longest axis, forming a tongue, as shown in Fig. 13 (a); the same form of cut is made in the lower end of the scion, as shown in (b). The two parts are then forced together as illustrated in (c). The tongues aid by locking the stock and scion together. Some difference in diameter of the stock and scion may be disregarded, but in order to bring the growing part of the root and the scion in contact, the edge of the scion and

stock must be even on one side. After the stock and scion have been united they should be wrapped with five or six turns of waxed string to hold the parts together, as shown in (d).

When roots are whip grafted, it is not necessary to use wax, because the soil will keep out air; but when tops are whip grafted the wound must be thoroughly waxed. The roots for grafting are dug and the scions are cut in the fall and the work of grafting is done during the winter. As the grafts are made they are packed in moss, sawdust, or sand in a cellar at a temperature of about 40 degrees, where they remain until spring. In making the graft, the roots are sometimes cut into two or three pieces and each piece grafted to a scion; this is known as **piece-root grafting**; or the top half or two-thirds of the root only may be grafted, which is known as a **whole-root grafting**. Ordinarily, in making the whip graft, the scion is cut with three buds and the stock to nearly the same length as the scion, and the graft is planted so as to bring the union not far below the surface of the ground. When it is desirable to produce very hardy trees and the scions to be used are of known hardiness and the roots are of unknown hardiness, the scions are cut from 6 to 12 inches long and the roots only from 2 to 4 inches long and the graft is planted deep enough to cause roots to spring from the lower end of the scion. The piece of root simply acts as a nurse until roots have started from the scion. When these young trees are removed to an orchard the original root is often cut off; this is not done when the root is strong and the union good.

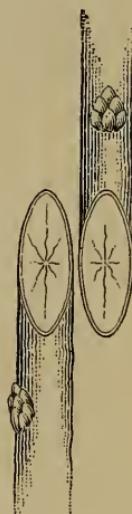


FIG. 14

25. Splice Grafting.—A method of grafting known as **splice grafting** is illustrated in Fig. 14. This is the same as whip grafting, except that no tongue is cut. The sloping surfaces of the stock and scion are brought together and the two pieces are bound with waxed string.

26. Veneer Grafting.—A method of grafting known as **veneer grafting**, which may be used for root or stem grafting,

is illustrated in Fig. 15. The top of the stock is removed with a slanting cut and a notch cut in it as shown in (a); a corresponding notch is cut in the scion as shown in (b), and the two

parts are brought together and bound with raffia or waxed string as shown in (c). The joint of a stem graft must be thoroughly covered with wax; this is not necessary in the case of a root graft.

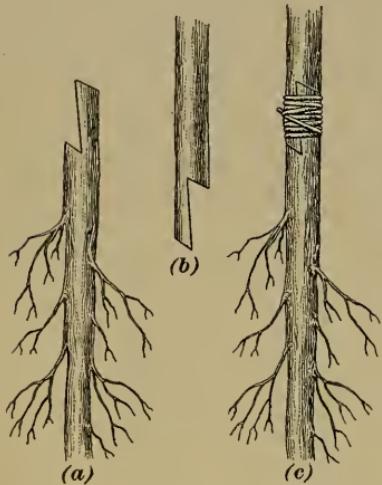


FIG. 15

of a stock. The operation of budding may be performed at a time when the bark can be loosened easily, and when mature buds can be obtained. These conditions are found to exist in the early spring and again in the late summer or early fall. The buds for use in the spring are taken from the previous season's growth, and those used in the late summer or early fall are taken from the growth of the season. It is possible to insert buds in the tops of young trees in place of scions in order to change the variety; in some cases buds have been inserted in limbs 2 or 3 years old, but a better practice is to cut back the tree rather severely the season previous to budding, in order to get a growth of suckers in which to set the buds. The important use of budding, however, is on 1-year-old stocks for transplanting. The operation of budding is simple and with a little experience may be performed very rapidly. When a number of stocks are to be budded the operator first prepares a bud stick, which is a twig of the species desired to propagate containing a number of buds. When the budding is done in the early spring the bud stick will be of the previous year's growth; if the budding is done in the late summer or early fall the bud

PROPAGATION BY BUDDING

27. A method of propagation much used for stone fruits and to some extent for apples and pears is known as **budding**. This consists of inserting a single detached bud under the bark

stick will be a twig of the current year's growth. When the work of budding is done during the period of active growth, the leaf that grows just below each bud is severed just as soon as the bud stick is cut, leaving the petiole, or stem, of the leaf attached to the stick to serve as a handle to aid in pushing the bud into position. All of the buds on a stick are usually cut before any of them are placed, but they are allowed to hang to the stick by one end until they are needed, when the final cut that severs them from the stick is made. A bud is first cut by inverting the twig and then placing the edge of a sharp, thin-bladed knife a little above the bud and the thumb of the hand in which the knife is held just below the bud and giving a quick, sharp turn with the blade.

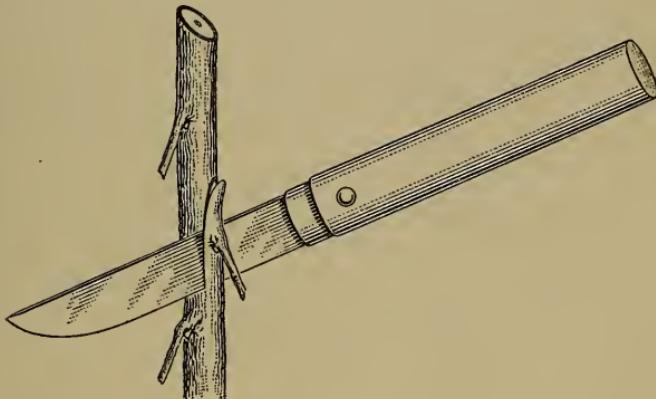


FIG. 16

In Fig. 16 is shown the manner of making the first cut in removing a bud from the stick.

Fig. 17 represents a bud stick, showing in outline the cuts that should be made for removing the buds. The knife will cut into the wood a little just under the bud, leaving a small part of the wood attached to the under side of the bud. Some budders remove this wood, although this is not necessary; however, there is a little more certainty of a union if the wood is removed. The stock for budding should be at least as thick as an ordinary lead pencil. The peach will reach this size and may be budded the first season after the seed is planted; apples and pears will not be of sufficient size before the second

season. The stock is first prepared by removing all buds and twigs from the area to be budded. The leaves should not be removed more than a day or two before the budding is done or the bark may set—that is, grow fast to the wood—and interfere with the operation of budding. The bud is usually placed on the stock not over 2 or 3 inches above the surface of the ground and in most cases is placed on the north side of the stock so that the bud may be shaded somewhat from the direct rays of the sun.



FIG. 17

For the reception of the bud, a T-shaped incision is made just through the bark as shown in Fig. 18 (a). The cross-cut is usually made first, and after making the last cut the knife blade is turned to the right and to the left to loosen the flaps of bark as shown in (b). A bud is then placed under the flaps and pushed firmly into place until the under surface is entirely in contact with the body of the stock. A bud in place is shown in (c). The bud must now be tightly bound into place, for which purpose bands of raffia from 8 to 10 inches long are most convenient. A few turns should be taken below and above the bud and the strands may be held by drawing them under one of the wraps. A stock with bud inserted and wrapped is shown in (d).

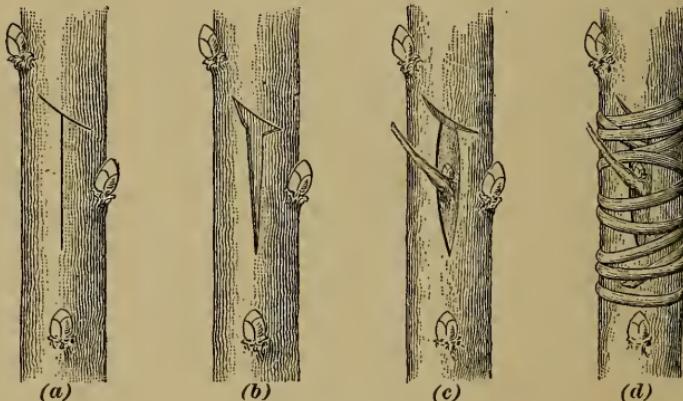


FIG. 18

To prevent girdling, the band should be cut as soon as the

bud has united to the stock, usually about 2 or 3 weeks after the setting of the bud. It is very important that all sprouts that spring from the stock after the budding should be removed so that the plant food that they would consume may be utilized by the bud. When growth starts in the bud, the entire top of the tree is removed just above the bud, which will then grow rapidly, being nourished by the entire root system of the tree. When the bud is set late in the season it does not start growth that fall, but simply grows fast to the stock; growth starts the next spring, at which time the top of the tree is removed. Spring budding of fruit trees is seldom practiced. In Fig. 19 the removed top *a* and growing bud *b* are shown.



FIG. 19

PRUNING OF FRUIT PLANTS

PRINCIPLES OF PRUNING

PURPOSES OF PRUNING

28. Some of the purposes of pruning fruit plants are to thin out the branches in order to allow the remaining branches sufficient room and light; to keep the plants in manageable shape; to regulate the size of the plants to the place they occupy; to establish a proper balance between wood and leaf growth and the production of fruit; to remove injured or diseased parts; and to facilitate spraying and other work in the orchard.

Most plants tend to produce a surplus of branches. In nature, many of these branches are gotten rid of by a self-pruning process; that is, they die from being crowded by other branches or by adjacent trees. The fruit grower usually

prunes out the branches that would die from being crowded and any other branches that are no longer advantageous to the tree. The thinning of branches is like killing weeds in a garden. In killing weeds, the gardner gets rid of certain plants in order to give more room to those that remain. In pruning, the fruit grower gets rid of certain branches in order that those that remain may have more space, more sunlight, or better shape, and a large quantity of plant-food.

On many fruit plantations branches grow so densely that it is inconvenient to get to the parts of the tree or plant in order to pick the fruit or to perform some work in caring for them. For each species of fruit tree or plant the grower usually has a pretty definite ideal of proper distribution of parts or branches, and he prunes out the branches so that the tree or plant conforms to his ideal.

The fruit grower frequently prunes plants that are weak or trailing on the ground in order that they will grow stockier and straighter and will stand up better than they grow or stand normally. Branches that would trail on the ground if allowed to grow their full length are shortened so that the fruit produced on them will be better supported by the plant. This practice is particularly common in the management usually accorded grapes, raspberries, and blackberries. Some fruit trees normally grow very tall. The fruit grower may cut back the top on the main stem of such plants in order to secure a lower and a more spreading form of top, which will enable him to take care of the tree and to gather the fruit more readily than if the top were high and upright.

29. Trees or other plants growing at regular distances apart may be kept from interfering with each other by pruning back certain parts. Many species of fruit, the peach, for example, tend to bear much of their fruit on the new wood, or periphery, of the tree, and, if allowed to grow unpruned, the tree eventually bears fruit only toward the tips of tall or wide-spreading branches. In many such cases, it is economy to cut back the branches from time to time, thus keeping the fruit-bearing area nearer the main support, or trunk, of the tree.

Certain varieties of fruits in certain soils or climates may tend to set more fruit than they can mature properly, that is, they may tend to overbear. In certain other locations these same varieties may tend to produce wood and leaf growth and to set very little fruit. If a plant or tree sets a larger number of fruit buds than it can support fruit, it will be economical to thin the fruit crop by pruning out some of the fruit-bearing twigs and branches, even before the tree blossoms. This removal of a part of the fruiting area may allow the tree to give its entire vigor and strength in support of the fruit that remains. If a plant produces but little wood and leaf growth, pruning at the proper time of year may do much toward invigorating the wood and leaf growth of those parts that remain.

Just as dwarf or standard plants may be chosen to suit the purpose of the grower, so any plant, by the pruning that it receives, may be dwarfed or made to grow larger than an unpruned plant. The tree may be pruned so as to reduce its stature, thus making it suit better a given position, or on the other hand, it may be pruned solely with the idea of invigorating the wood growth of the parts that remain, thus sometimes accelerating its growth and enabling it to reach a larger size than it would ordinarily attain.

30. Many of the diseases of fruit plants, such as blight, canker, black knot, etc., are due to fungi or bacteria that multiply rapidly and spread through a plantation, and these diseases may often be checked by the removal of the disease-infected parts by modern methods of pruning. As a rule, diseased or injured parts of trees or plants should be removed and no chances taken on the spread of the organism that causes the disease.

The general practice of spraying, in combating insects and fungous diseases of plants in recent years, has had much to do with stimulating careful pruning. In spraying, it is essential that all parts of a tree be covered with spray, but it is not feasible to get a spray to the body of a tree or to all of its branches unless the tree is well pruned and its branches well thinned. Trees need proper pruning, therefore, not only

after they have reached bearing age but while the framework of the young trees is immature, so they may be formed in such a way that they can be most readily sprayed when fully matured.

EFFECTS OF PRUNING

31. By judicious pruning branches or plants may be properly thinned, plants kept in proper shape and confined to the desired space, the proportion of wood and leaf growth to fruit production regulated, the spread of disease prevented, and the work of spraying facilitated. But pruning is the direct cause of other effects, some of which are desirable and some of which are undesirable.

Cutting back or thinning out the branches of a tree, especially during the winter, induces a more rapid growth of wood the following year on the remaining branches than if the pruning had not taken place. And, although a tree that has received much pruning may not, at maturity, be so large as a similar tree that has not been pruned, the former may, and in all probability will, have healthy, vigorous wood, and the unpruned tree, although larger, may contain many dead, dying, diseased, and undesirable limbs and branches. Thus, one of the important effects of pruning is the securing of a healthy, vigorous growth of the tree or plant.

The pruning of some of the fruit-bearing branches and the shortening of others is one of the best methods of preventing fruit trees from setting more fruit than they can fully mature, or, in other words, from overbearing. Thus, judicious pruning not only stimulates the wood growth of the subsequent season but, at the same time, leaves enough fruit buds on a tree to furnish such a crop of fruit as the tree can most economically produce; whereas, the unpruned tree may produce more fruit than it can mature and may make a very meager growth of wood that is often weak and diseased.

32. Pruning at different times of the year produces a different effect on the production of wood and fruit. There is an old adage that runs, "Prune in winter for wood and in

summer for fruit production." This statement is based on experience that has demonstrated the fact that excessive wood growth is usually developed at the expense of fruit production, and vice versa. In this connection, the fruit grower should keep in mind the distinction between the growth of wood and leaves, known as *vegetative activity*, and the production of blossom and fruit, known as *reproductive activity*. A fruit plant, to be in its best condition, should make enough vegetative growth to be healthy and yet produce such a quantity of fruit as is feasible without reducing the vitality of the tree. In such cases vegetative activity and reproductive activity are said to be in balance. Whenever, through injudicious pruning or any other phase of mismanagement, a plant makes more than normal vegetative growth, its tendency is to produce a small quantity of fruit. This is further emphasized by the fact that fruit trees that make abnormally rapid growth often fail to come into bearing at the expected time; they delay bearing until their excessive wood growth begins to wane. Also, pruning that results in an excessive growth of water sprouts, which are purely vegetative growths, results in no formation of fruit buds on these water spouts until their vegetative growth wanes. These facts should be contrasted with the well-known fact that an injury to a tree that checks its wood growth often results in an abnormally early fruitfulness or in a too abundant setting of fruit; a young tree affected by borers or accidentally injured by a cultivator or girdled by rodents may, by such an injury, be forced into excessive fruitfulness, although the vegetative growth of the tree is much weakened by the injury. It is, therefore, a generally conceded fact that the checking of wood and leaf growth often increases the production of fruit, and on the other hand, excessive fruit production, or overbearing, tends greatly to reduce the vegetative growth of the tree.

33. Pruning during the winter usually results in strong wood growth the following summer, and if excessive pruning is done during the winter it may prevent young trees from coming into bearing as early as they would without such

pruning and may reduce the fruitfulness of old trees. The probable reason is that a tree stores up a reserve supply of food and energy during the summer and that the early growth during the spring no doubt depends more on this stored food and energy than on immediate root action to supply plant-food. In fact, in cold soils, a tree often comes into leaf and bloom before its roots are warm enough to become really active in supplying food for the tree. If parts of the plant are removed in winter, then the stored food and energy of the tree is diverted into the fewer parts that remain. These remaining parts get the entire food supply that otherwise would have been distributed among the larger number of buds and branches, and the result is a stimulation of the wood growth on a tree pruned during the winter.

Pruning in summer, especially if the pruning is excessive, is likely to result in diminished wood growth. The probable reason is that after the early growth of spring has used up the available stored food and energy accumulated in the tree, subsequent growth depends on the food that is supplied by the roots from day to day. However, it should be borne in mind that the sap taken from the soil through the roots of the tree is not immediately in a condition to promote growth or the building of tissue. The sap is first carried from the roots into the leaves where, in the presence of the green coloring matter, it is elaborated, or digested, and is then transported to all the growing parts of the tree where it promotes growth. Regardless of how much sap the roots are taking from the soil, no more plant-food can be utilized for growth than is elaborated in the leaves. As pruning in summer removes leaves, or a part of this elaborating surface of the tree, the quantity of plant-food that is elaborated is reduced. As a result, vegetative activity is in a measure checked, and, if not carried too far, may result in a tendency to reproductive activity and throw the trees into bearing.

34. So long as all available plant-food is being directed toward the tips of rapidly growing twigs, it cannot be used for fruit-bud formation. Fruit buds of practically all fruit-pro-

ducing plants are usually formed the season before the blossoms and fruit are produced. In spring, so far as is known, all the buds on the new growth start alike, as wood buds. If excessive vegetative activity continues throughout the season to carry all available food to make growing points and leaves, these buds will remain as wood buds. However, if part of the plant food that is being elaborated in the tree can be directed in early summer, perhaps in June, to storage in some of these buds, they may be transformed into fruit buds. The setting of fruit buds is, therefore, apparently due to the storage of an abundance of available plant-food, so that buds which started as wood buds can receive a sufficient share to develop into flower or fruit buds. These fruit buds continue to develop more and more throughout summer and autumn. If the storage of plant-food in and adjacent to the fruit buds is abundant, they should be thoroughly developed by autumn, pass the winter safely, produce flowers in spring, and the flowers should be followed by a fruit crop. But anything that tends to divert available plant-food during the summer away from the fruit buds oppose fruitfulness for the coming year. The fruit-bearing parts of certain kinds of plants, especially the grape, blackberry, and raspberry plants, are so weakened by bearing a crop of fruit that they are not desirable for subsequent fruit production. In such cases, regular pruning is particularly necessary to remove those parts that have once borne fruit and to shape new parts for the production of the next fruit crop.

METHOD OF PRUNING

35. In various parts of the world numerous forms and heights of heads of trees have been advocated and maintained by fruit growers. In the United States, one of the most important classifications as to shape of tree is based on the height of the head. In Europe, fruit trees are often trained to grow open heads of wine-glass, or vase, form in order to expose all parts of the head to sunlight. Also, they are often trimmed and trained so that the branches spread out flat against a trellis or the south side of a wall. An apple tree

pruned and trained to grow on the side of a wall is illustrated in Fig. 20, and another one pruned to two horizontal branches

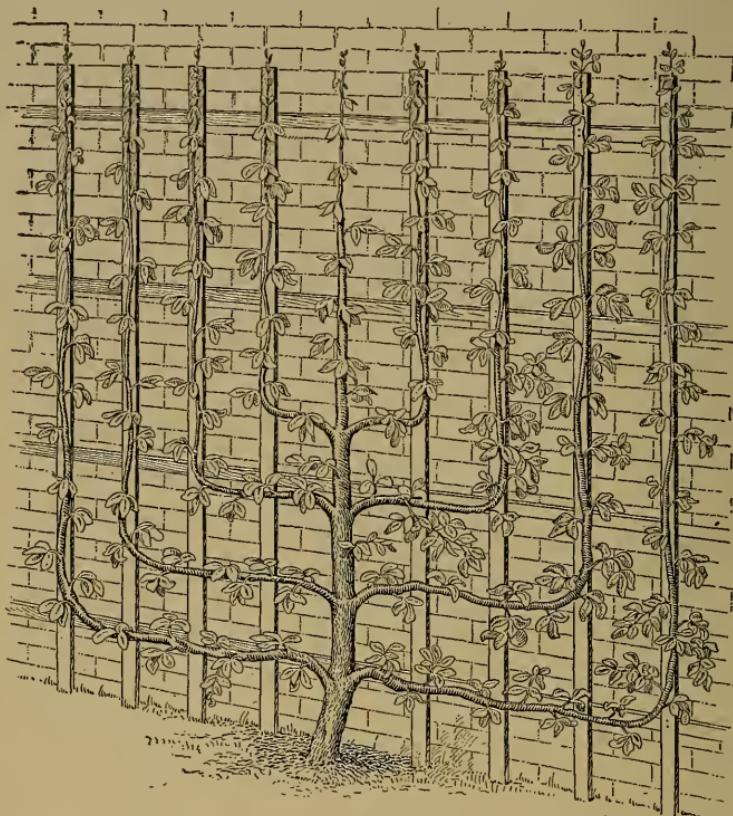


FIG. 20

that are trained to grow on a horizontal support only 2 feet above the ground is shown in Fig. 21.

In regions with very severe climate, fruit plants are sometimes laid down and protected during the winter. In such



FIG. 21

cases a special form of pruning is given to the plants to adapt them to the winter protection. Thus, the trees may be grown

in a more or less flattened form; the branches on the north and south sides are pruned very short and those on the east and west sides are allowed to grow long. The root system is also cut back more or less on the two flattened sides of the tree so that the main brace roots extend laterally in the same directions as the spread of branches. This form of pruning admits of laying down tender trees for winter protection without breaking either the essential roots or the essential branches.

36. High-Headed and Low-Headed Trees.—In the early settled regions of the United States where orchards were first planted it was usually customary to grow very high heads on fruit trees. Often the heads were started 7 or 8 feet above the ground, so that persons could walk upright below the branches and teams could be driven under them to till the soil. But, at the present time in many parts of the United States and Canada, heads so low as to stand very close to the ground frequently prevail. The reason for the difference in the position of the heads of fruit trees in regard to the height of the head is that the character of the head of a fruit tree bears an intimate relation to its adaptation to a given climate and to the management that may be given to an orchard. In Europe, where most of the fruit-producing plants grown in the United States were formerly obtained, a comparatively foggy climate prevails. Practically all of Europe and the adjacent islands has a much more humid climate than has the United States. Europe has a less changeable climate, especially with respect to devastating winds than most parts of the United States.

In a section where sunlight is inadequate to the best development of fruit trees, a high, open head will best admit sunlight to all parts of the trees and allow the ground to become warm and dry under the trees. But in most sections of the United States, where the sunlight is intense, and especially in those sections where drying winds prevail, low heads are grown. Choosing the height and character of the head is, therefore, one important way of adapting fruit trees to the climate of the locality in which they are planted. Where the maximum

sunlight is needed by the trees and to warm and dry the earth beneath the tree, high heads are probably best; where it is desirable to shade the ground, protect the trunk and main branches of the trees from sun scald and to resist the force of strong winds, low, compact heads are desirable. In practically all parts of the United States in recently planted orchards low heads have been almost universally adopted. Typical high-headed trees are found only in old orchards. A tree headed low can be brought into bearing earlier than one headed high, because very high heads are secured only by cutting off annually the side branches that form during the first 2 to 4 years of the growth of the trees, and this pruning delays the times when branches shall be old enough to produce fruiting parts.

Low-headed trees are stocky. There is usually a correlation between root growth below ground and branching above ground. An unusually large limb above ground is ordinarily balanced with a similarly large root below. The same strands of woody fibers that form the roots extend upwards to help form the branches, and, as the roots spread from the base of a tree, an enlargement of the trunk is produced. Frequently large roots form flanges that broaden rapidly as they enter the ground; a similar broadening effect occurs where the branching system begins at the top of the trunk; and the nearer together these two points are, the larger will be the diameter of the trunk of the tree at a given age.

Measurements of the diameter of the trunks of low-headed and high-headed trees show that the lower the head the thicker will be the trunk. In one 8-year-old orchard where a comparison of the two methods of heading was made, the low-headed trees with trunks only 18 inches high were 50 per cent. greater in diameter at their smallest point than were the trunks of high-headed trees of the same variety.

In sunny climates low-headed trees tend better to shade the trunks and main branches and thereby to avoid sun scald than do high-headed trees. Winds do not damage low-headed trees so much as high-headed trees nor blow the fruit from them so readily. The fruit on low-headed trees can to a large

extent be picked from the ground, and the pruning and spraying may be more conveniently done than if the trees were high headed.

High heads may, in moist, foggy climates, allow the sun more quickly to warm and dry the soil and decomposing material beneath the trees. The moist, decomposing material and the moist condition of the soil favor the development of such fungi as may cause disease. Certain orchard tools can be used more conveniently in high-headed orchards than where the branches come down close to the ground. Also, high heads admit of a better growth of any crop that may be grown in the orchard.

It seems safe to say, however, that the advantages of low heads so largely outweigh the advantages of exceedingly high heads that it is probably wise to adopt as low heads for fruit trees as are compatible with the character of soil and the prevailing climatic conditions.

37. Styles of Pruning.—The style of pruning that eventually allows a fruit tree or plant to develop to its largest possible size is known as **extensive pruning**. It consists of a thinning-out process rather than a cutting-back process and is particularly adapted to such trees as the apple and the pear, that bear fruit on short fruit spurs all over the tree, rather than to such trees as the peach, that bear fruit on the new, growing parts.

The style of pruning that tends to dwarf plants or trees is known as **repressive pruning**. It is accomplished by cutting back new growth and may or may not be accompanied by thinning out the branches. Repressive pruning is commonly practiced on plants that bear fruit toward the extremities of new growth, such as the peach, raspberry, blackberry, and grape. If this style of pruning is not practiced on such trees as the peach, the limbs are very likely to become long and to break under a heavy load of fruit and the trees will occupy more space in an orchard than is necessary or desirable for them to occupy. Repressive pruning results in a stocky, strong tree or plant, prevents limbs from breaking down with fruit, keeps

the trees within desired limits, causes the fruit to be produced where it can be picked easily, and produces plants and trees that are easily sprayed.

TOOLS AND MATERIALS FOR PRUNING

TOOLS FOR PRUNING

38. The tools to be used in pruning operations depend somewhat on the character of the plant to be pruned. For small

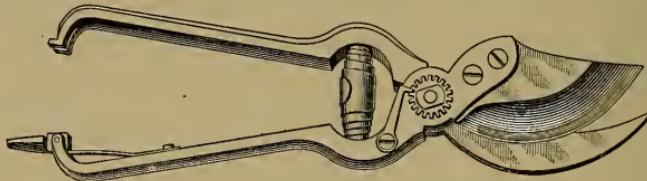


FIG. 22

plants such as grape and berry plant, whose parts are flexible, shears are most largely employed. For young orchard trees whose branches are small, the pruning knife is preferred by

most fruit growers. For old orchard trees where large limbs or diseased parts are to be removed, the pruning saws are indispensable. Ladders may also be necessary in the case of trees that have reached large size.

39. Pruning Shears.—The shears most commonly used in pruning operations are hand shears of the type shown in Fig. 22. The shears illustrated have a ratchet nut on the side, a device that prevents the cutting part from binding or from becoming loose. In different shears there are often slight differences in the kind of spring between the handles and the attachment for fastening the handles together while the implements are not being used. For the pruning of mature trees, such implements as are shown in Fig. 23 are often found to be

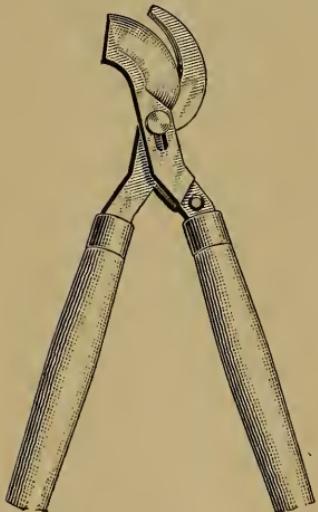


FIG. 23

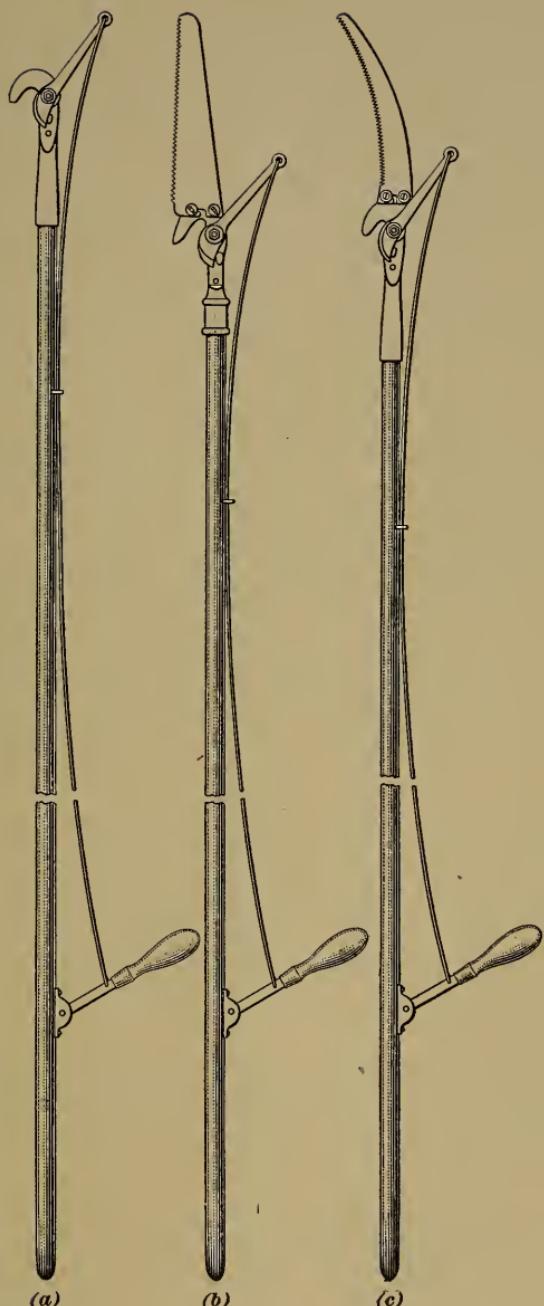
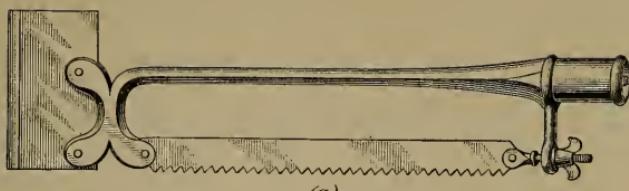


FIG. 24

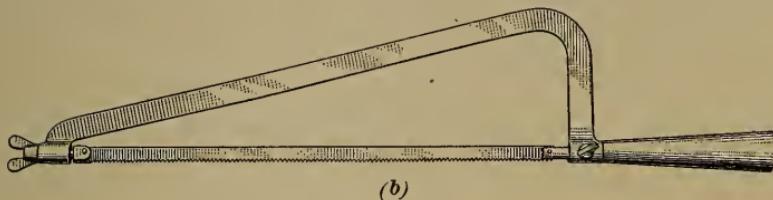
very convenient. They are equipped with wood handles about 2 feet long and are especially useful in young orchards where many limbs and branches are to be removed that are too large to be cut off with ease by means of the hand shears shown in Fig. 22. The shears shown in Fig. 24 (a), (b), and (c) are known as *long-handled*, or *extension*, *shears* and are almost indispensable in pruning mature orchards. These shears can be equipped with handles 4, 6, 8, or 10 feet long. The cutting part is operated by means of a wire extending from one end of the cutting part to a hand lever that is fastened to the long handle near its free end. A plain, single pair long-handled shears is shown in (a), and combination shears and saw, in (b) and (c). Either of these latter implements are of especial value in removing branches that are too large to be cut off by the shears. The implement shown in (b) is of such a size as to clip off limbs $\frac{3}{4}$ inch in diameter and the saw is the ordinary type of hand saw. The shears of the implement shown in (c) will only clip off branches $\frac{1}{2}$ inch or less in diameter, and the saw is of a special curve shape, the teeth of which are so made that they cut most while the saw is being pulled rather than pushed.

40. Pruning Saws.—Among the implements of the fruit grower should be found one or more desirable pruning saws, several types of which are shown in Fig. 25. That type of saw with a thin, slender blade held rigidly in a steel frame that bows backwards several inches from the blade is a very popular saw, although many orchardists prefer the common type of saw.

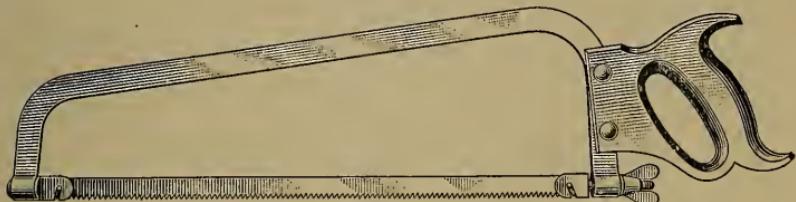
The implement shown in (a) is attached to a long handle and fastened to one end of the saw frame is a chisel. The chisel attachment is very convenient for punching off small branches such as water spouts close to the large limbs. Care, however, must be exercised in the use of the chisel or the limb from which the small branches are cut will be wounded. The saw illustrated in (b) is of a special tapering shape, and the blade, which is very narrow, is fastened by means of a swivel at each end to the frame, so that the plane of the saw



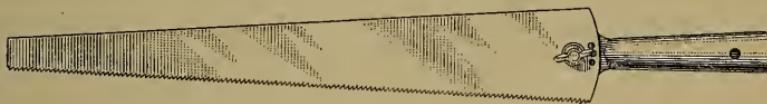
(a)



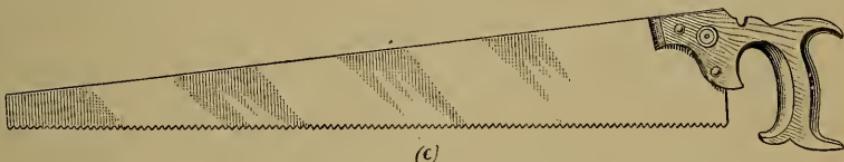
(b)



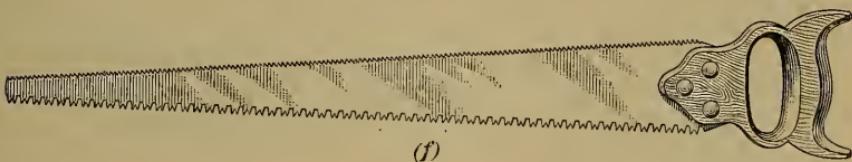
(c)



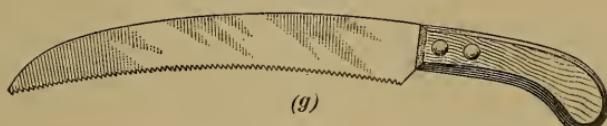
(d)



(e)



(f)



(g)

FIG. 25

blade may extend in one direction and that of the frame in another direction. This arrangement, it is claimed by some orchardists, makes this saw especially desirable to use in narrow places such as in the forks of limbs. The saw is equipped with a socket handle into which may be fitted a long handle or without the handle it may be used as a hand saw.

The saw shown in (c) is similar to the one shown in (b), in that the former has a slightly tapering frame and a narrow blade with a swivel at either end. The saw is equipped, however, with a regular type of saw handle that makes it more serviceable for close work than the saw shown in (b). The saw shown in (d) may be used as a hand saw or a pole may be fitted into the socket handle. An arrangement is provided so that the handle may be adjusted for sawing at different angles. The saw shown in (e) is equipped with a handle that may be hooked over a small limb or over a round of a ladder. The saw shown in (f) has teeth on both edges and by many orchardists is claimed to be a very convenient saw, but care must be exercised that one edge of the saw does not scratch one limb while another one is being sawed off. A curved saw preferred by many pruners is shown in (g). The teeth are made so that they cut while the saw is being pulled backwards rather than while it is being pushed forwards.

41. Pruning Knives.—Any good strong pocket knife may be used as a pruning knife, but knives made especially for pruning purposes, such as the one illustrated in Fig. 26, usually have a hook blade and a handle sufficiently large and of such a shape as to allow the pruner to get a firm grip.

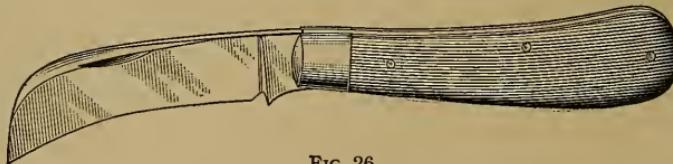


FIG. 26

42. Ladders for Pruning.—Ordinarily, the ladders that are used in the picking of any kind of fruit are the best suited for use in pruning the trees bearing the fruit. Step ladders are very commonly used.

DRESSINGS FOR WOUNDS

43. All wounds, whether they are the result of pruning or of accident, should be protected from the entrance of the germs of disease or of decay. Many infectious diseases, such as various cankers and blights as well as certain species of insects, may frequently find entrance to trees through wounds. To protect the tree from infection by disease or from rotting of the wood, all cuts larger than $\frac{1}{2}$ inch in diameter should be promptly covered by paint or other dressing. Of the numerous preparations that have been tried or recommended for the dressing of wounds, probably common white lead and oil paint is the most desirable. It can always be secured at any paint shop, is convenient to apply, and protects the wounds or the bare wood of the tree as well as most other dressings. Ordinarily, wounds should be painted as soon as they occur; at any event, the paint should be applied within 24 hours or as soon as the surface of the wound is dry. If it is desirable, for the sake of appearances, the paint may be colored the same general color as that of the bark of the trees.

Grafting wax is also a most excellent dressing for wounds. Where wounds are made for the insertion of scions, grafting wax is undoubtedly the best covering for the naked parts of the wood. It prevents the evaporation of moisture through wounds better even than paint; and, although it is more expensive and more troublesome to apply, there may be instances where it is desirable to use grafting wax to prevent evaporation or to secure greater protection to wounds than is given by paint.

ESSENTIALS OF FRUIT CULTURE

(PART 2)

SPRAYS AND THEIR PREPARATION

INSECTICIDES

1. An **insecticide** is defined by the law passed by the United States Congress in 1910 as "any substance or mixture of substances intended to be used for preventing, destroying, repelling, or mitigating any insects which may infest vegetation, man, or other animals, or households, or be present in any environment whatsoever." In the ordinary usage of the term, however, any substance that kills insects is an insecticide. All insecticides may be divided into two general classes, *poisonous insecticides* and *contact insecticides*.

POISONOUS INSECTICIDES

2. Insecticides containing a poison that will kill insects are known as **poisonous insecticides**. They are used for insects that have mouth parts for biting and that feed on the surfaces of plants. The poisonous insecticides generally used are *arsenate of lead*, *Paris green*, *arsenite of lime*, and *London purple*, all of which contain arsenic in some form. *Hellebore* is a poisonous insecticide not containing arsenic that is occasionally used.

3. **Arsenate of lead** is at the present time the most valuable poisonous insecticide for spraying purposes. A great

advantage this poison has over other arsenical poisons is that it contains very little soluble arsenic—that is, arsenic soluble in water. Soluble arsenic is injurious to fruit and foliage and for this reason must be guarded against as spray material. The advent of arsenate of lead as a spray has made spraying for insect enemies of the peach possible, as no other arsenical poison can be used on peach trees because of burning the foliage. Arsenate of lead is more effective than other arsenic insecticides, because it can be used in large quantities. Another advantage is that it stays in suspension well, and thus a uniform mixture can be sprayed. In addition, it adheres to the foliage well, not being easily washed off by rain. Also, it has some value as a fungicide—a property that increases its value to the orchardist.

Arsenate of lead is generally sold in the form of a paste containing about 50 per cent. of water. In this form it is used at the rate of 2, 3, or 4 pounds to 50 gallons of water, the exact quantity depending on the species of tree to be sprayed and the pest to be controlled. Some companies manufacture, also, a dry form of arsenate of lead, of which only one-half as much should be used as of the paste form. Arsenate of lead can be made at home possibly for a little less than it would cost if purchased, but it is not possible to be so certain of the strength of the home-made preparation, and unless a very large quantity is needed it will generally be found more satisfactory to purchase the material. Arsenate of lead is made by combining arsenate of soda with acetate of lead. When the insecticide is to be made in any considerable quantity it is well first to make up stock solutions of the two substances. For the stock solution of arsenate of soda, 31 pounds 4 ounces of arsenate of soda should be dissolved in 50 gallons of water. The solution can be made most satisfactorily by suspending the arsenate of soda in a burlap bag or some other porous container just below the surface of the water near the top of the containing barrel. In another barrel, 78 pounds 2 ounces of acetate of lead should be dissolved in 50 gallons of water by suspending it in the same way. After a thorough stirring of both solutions, 1 gallon of each with sufficient water added

to make 50 gallons will form a spray solution of the same strength as 2 pounds of arsenate-of-lead paste in 50 gallons of water. The arsenate-of-soda and acetate-of-lead solutions should be poured simultaneously into a spray barrel containing the required quantity of water.

In making the spray mixture with the manufactured preparation, either the paste or the powder, the required quantity of poison should be weighed out and water added a little at a time, the mixture being stirred until a thin, milky liquid is formed. This liquid is then poured into sufficient water to form a spray mixture of the required strength. If the mixture is not prepared in this way it will not become uniform for several hours. A large quantity of the milky liquid may be conveniently prepared by using an old stone churn or a keg with a dasher for doing the mixing.

A purchaser of arsenate of lead in the United States may be reasonably sure of getting an honest brand, as the specifications of the United States insecticide law already referred to are exacting. Sec. 7 of the law specifies that arsenate of lead shall be deemed adulterated:

"First, if it contains more than 50 per centum of water; second, if it contains total arsenic equivalent to less than $12\frac{1}{2}$ per centum of arsenic oxide, As_2O_5 ; third, if it contains arsenic in water-soluble forms equivalent to more than $\frac{75}{100}$ per centum of arsenic oxide, As_2O_5 ; fourth, if any substances have been mixed and packed with it so as to reduce, lower, or injuriously affect its quality or strength. *Provided, however,* that extra water may be added to lead arsenate if the resulting mixture is labeled lead arsenate and water, the percentage of extra water being plainly and correctly stated on the label."

4. Paris green is probably the best known insecticide on the market. It was the material most largely used as a poisonous spray before arsenate of lead came into general use. Paris green can be easily recognized by its beautiful green color. It contains much more soluble arsenic than does arsenate of lead, and is, therefore, much more injurious to foliage and

should not be used on tender-leaved plants such as peaches, cherries, or plums. For a spray compound 1 pound of Paris green is generally added to from 75 to 150 gallons of water. When used in pure water, 2 or 3 pounds of freshly slaked lime should always be added to 50 gallons of the spray, as this will combine with any free arsenic that may be present and so lessen the liability of injuring fruit and foliage. Paris green does not stay in suspension well, and for that reason when it is used as a spray thorough agitation is necessary. Although cheaper than arsenate of lead, it is doubtful whether, under present conditions, the use of Paris green for spraying fruit plants is advisable. If it is used it should first be mixed with a little water to form a thin paste and then be poured into the spray tank or barrel; if it is poured into the spray barrel in a dry form, it will remain on top of the water without mixing.

Sec. 7 of the United States insecticide law specifies that Paris green shall be deemed adulterated: "First, if it does not contain at least 50 per centum of arsenious oxide, second, if it contains arsenic in water-soluble forms equivalent to more than $3\frac{1}{2}$ per centum of arsenious oxide; third, if any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength."

5. Arsenite of lime, an insecticide that may be easily made at home, consists of a combination of arsenic and lime. This poison has the advantage over arsenate of lead and Paris green of being much less expensive. Also, it is lighter than Paris green, and for this reason remains in suspension much better. The great disadvantage of arsenite of lime as an insecticide is its injurious effect on foliage, which is much greater than that of either arsenate of lead or Paris green.

One of the best methods of making arsenite of lime is to boil 1 pound of white arsenic and 2 pounds of good stone lime in 2 gallons of water for 40 minutes. Water should then be added to make this mixture up to 300 gallons. As a spray the mixture will be as effective as one consisting of 1 pound of Paris green to 150 gallons of water.

Another method of making arsenite of lime is to boil in an iron kettle 1 pound of white arsenic and 4 pounds of sal soda in 1 gallon of soft water until the arsenic dissolves. A small quantity of muddy sediment will usually be found in the bottom of the vessel; this should be discarded. The product thus made is arsenite of soda, which is one of the ingredients to be used in making the arsenite of lime. The arsenite of soda should be kept in a tightly closed jug until needed for use. To make the arsenite of lime, 2 pounds of good stone lime is slaked and diluted with 2 gallons of water; to this is added 1 pint of the arsenite of soda, and the mixture is stirred until thoroughly combined, when water should be added to make 40 gallons. This solution will be equivalent in strength to a solution of 1 pound of Paris green to 160 gallons of water. The arsenite of soda must never be used alone as a spray, because it will kill all foliage with which it comes in contact.

6. London purple is a by-product obtained in the manufacture of aniline dyes. This substance contains poison in the form of arsenite of lime. London purple varies greatly in composition and is thus likely to be ineffective, or, if used in effective quantities, is likely to injure the foliage badly; it is, therefore, not used to any extent in orchard work.

7. Hellebore is a poison made from the powdered roots of white hellebore and it is sometimes recommended as a substitute for arsenical poisons where insects must be combated on nearly ripe fruit. This poison may be mixed with from 5 to 10 parts of flour or of lime and applied dry, or it may be diluted with water, 1 ounce of hellebore to 1 gallon of water, and used as a spray. Hellebore is reasonably effective against insects and is practically harmless to man in the quantities recommended; it is, however, too expensive to be used except on small home plantings.

CONTACT INSECTICIDES

8. Substances used to kill insects simply by coming in contact with them are called **contact insecticides**. They can be used successfully as sprays against many soft-bodied insects, such as plant lice, and also against those that are stationary during the greater part of their lives, as, for example, the San José scale. Insects that have sucking mouths instead of biting mouth parts cannot be destroyed by poisoning their food but must be killed by contact insecticide sprays. Among the most important contact insecticides are *lime-sulphur*, *self-boiled lime-sulphur*, *miscible oils*, *distillate oils*, *kerosene emulsion*, and *tobacco extracts and decoctions*.

9. **Lime-sulphur**, a combination of lime and sulphur, has during recent years come into general favor as a contact insecticide and has also been found to have some value as a fungicide. It may be purchased from a number of chemical manufacturing houses or may be readily made at home. When sulphur and lime for making this solution are purchased in large quantities, the materials necessary to make a barrel of the concentrated solution will cost between \$2 and \$3.50. The entire cost, including fuel and labor, will be much less than the cost of the commercial solution.

Many different formulas have been recommended for the making of lime-sulphur, but the one at present considered most satisfactory is as follows: 1 pound of the best stone lime and 2 pounds of flowers of sulphur or of ground sulphur, which are boiled in enough water to make 1 gallon of solution. To make 50 gallons of solution, about 10 gallons of water is placed in a kettle, the fire started, and 50 pounds of lime added; after the slaking is well started, the dry sulphur is added and thoroughly mixed with the slaking lime, enough water being added to maintain a thin paste. A stick graduated so that a certain depth of liquid in the kettle measured by this stick will be 50 gallons is convenient for determining the quantity of liquid in the kettle. After the slaking is complete and the lime and sulphur are thoroughly mixed, enough water is added

to bring the liquid in the kettle to about 55 gallons, and the boiling is continued until the quantity is reduced to 50 gallons. The material must be kept well stirred, especially during the earlier stages of the boiling, and any lumps of sulphur must be thoroughly broken up. The liquid should generally be boiled for an hour, but a variation of 10 minutes either way is not harmful.

10. Another satisfactory method of combining the lime and sulphur with the water is to place about 45 gallons of water in the kettle over the fire and put in the lime. While the lime is slaking 15 or 20 pounds of sulphur should be placed in a large wooden pail or small butter tub, 1 gallon of water added, and the compound worked to a smooth paste with a paddle; if another gallon of water is now added and thoroughly stirred into the sulphur a very thin paste will be formed which may easily be poured into the kettle. Another quantity of sulphur should then be prepared in the same way and the process continued until all of the sulphur has been added. In using this method, it will probably not be necessary to put more water into the kettle after the sulphur has been added, because of the quantity of water used in making the paste. Dry sulphur should never be added to a large quantity of water, because the sulphur will form into lumps and it is then very difficult to get it combined with the lime. When the boiling is finished, the solution should be poured or strained into a barrel or settling tank.

When a steam boiler is available a wooden or metal tank may be used with steam turned in to do the cooking; if the steam is turned in at the bottom of the tank less stirring will be necessary.

11. Before lime-sulphur is placed in the spray barrel or tank it should be carefully strained, because it always contains considerable sediment that will not pass through the spray nozzle. Several forms of strainer have been devised for this work, but in all cases where the solution passes down through the strainer the screen soon becomes clogged with sediment and causes much trouble. To obviate this difficulty, a strainer

has been devised at the Pennsylvania State College Experiment Station so arranged that the liquid is forced to rise through the screen. This strainer is illustrated in Fig. 1 and a sectional view with dimensions is shown in Fig. 2. The liquid is poured into the strainer at *a*, passes up through a removable wire screen *b* held in place by revolving cleats *c*, and passes out through the faucet *d*. The screen may be of either tinned iron wire or brass. Tinned iron is preferable for lime-sulphur, but if the strainer is also to be used for Bordeaux mixture, brass screening should be used. The screen

should be fine, having a mesh of from 30 to 40 to the inch.

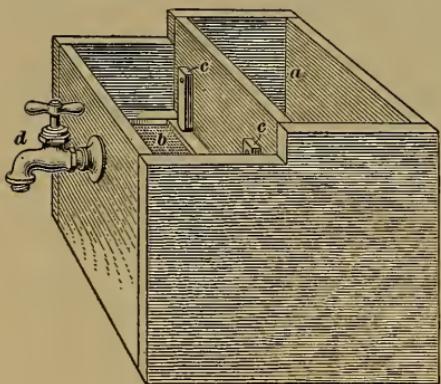


FIG. 1

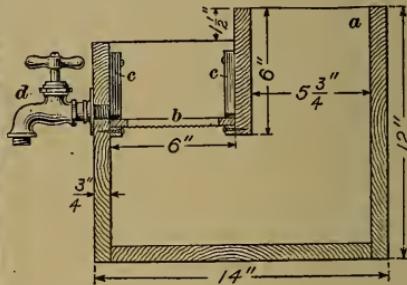


FIG. 2

The small quantity of solution that remains in the strainer may be saved by allowing water for the next boiling to run through the strainer.

12. Lime-sulphur should be stored in closed barrels, because exposure to air causes a crust of crystals to form on the top; this crust, however, can be brought back into solution readily by dipping it off and boiling it for a short time. If the barrel is not closed, a very good method of preventing the formation of these crystals is to pour a layer of paraffin or of oil of any kind over the surface of the liquid.

13. The question of a convenient method of cooking lime-sulphur is worthy of some consideration. When only a small quantity of the concentrated solution is required, very simple means for cooking may be employed, and even when a large quan-

tity is required it is not necessary to have elaborate or expensive apparatus. A simple apparatus is shown in Fig. 3. It consists

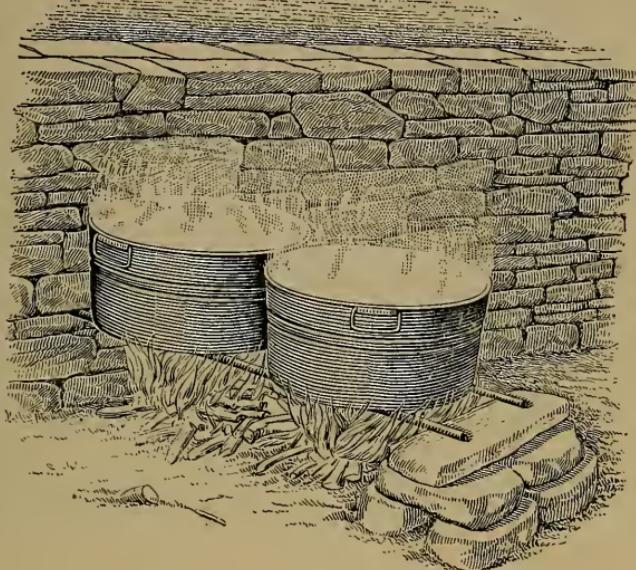


FIG. 3

of galvanized-iron wash tubs of large size supported over a fire on iron rods. The tubs must not be full, because the solution is likely to boil over.

About 5 gallons of concentrate can be cooked in a large-sized wash tub.

In Fig. 4 is shown a cooker often used for cooking feed, making soap, etc. Such a cooker may be used for making lime-sulphur. It should not be filled much more than half full on account of the likelihood of boiling over.

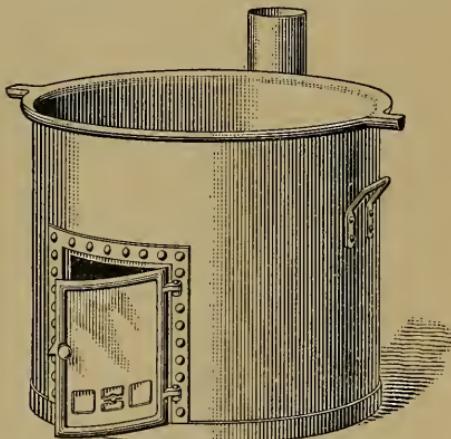


FIG. 4

An inexpensive tank for boiling 50 gallons of solution is illustrated in Fig. 5. The sides and one end are made of 2-inch

plank 12 inches wide and the bottom and one end are made of sheet iron. The plank for the one end is 1 foot 10 inches long; the side planks are 7 feet long, and are cut to a slant at one end from a point *a* 1 foot from the end to the corner *b*,

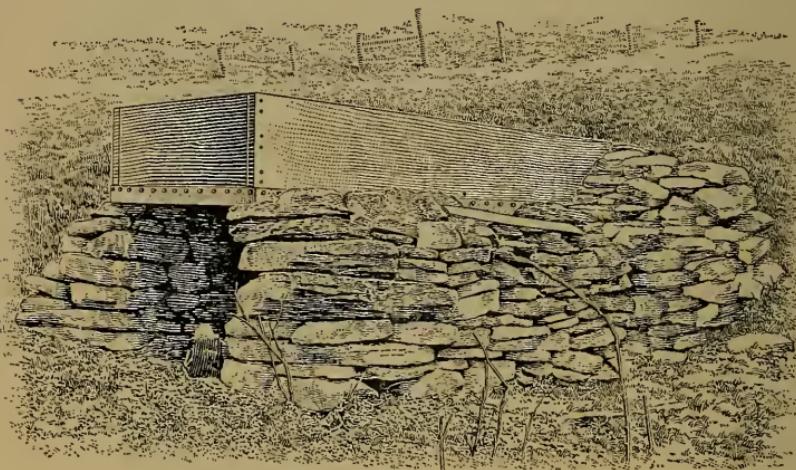


FIG. 5

as shown by the dotted line in Fig. 6. The sheet iron for the bottom and one end is 7 feet 7 inches long and 2 feet 7 inches wide. These dimensions provide for turning over the edges $2\frac{1}{2}$ inches all around. The sheet iron should be well nailed to the planks and the crevices filled with white lead. This tank was set on a fireplace built of stone, as shown in Fig. 5. A view of the other end of the tank and the smoke vent of the fireplace is shown in Fig. 7. The cost of the tank, not including the labor, was about \$3. All the labor, with the exception

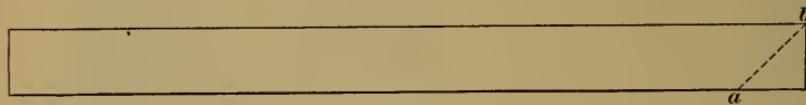


FIG. 6

of the cutting of the corners of the sheet iron and the turning over of the edges was done by the farmer himself.

14. A more elaborate cooking plant for lime-sulphur is shown in Fig. 8. The tank, which is of sheet iron, is set between



FIG. 7

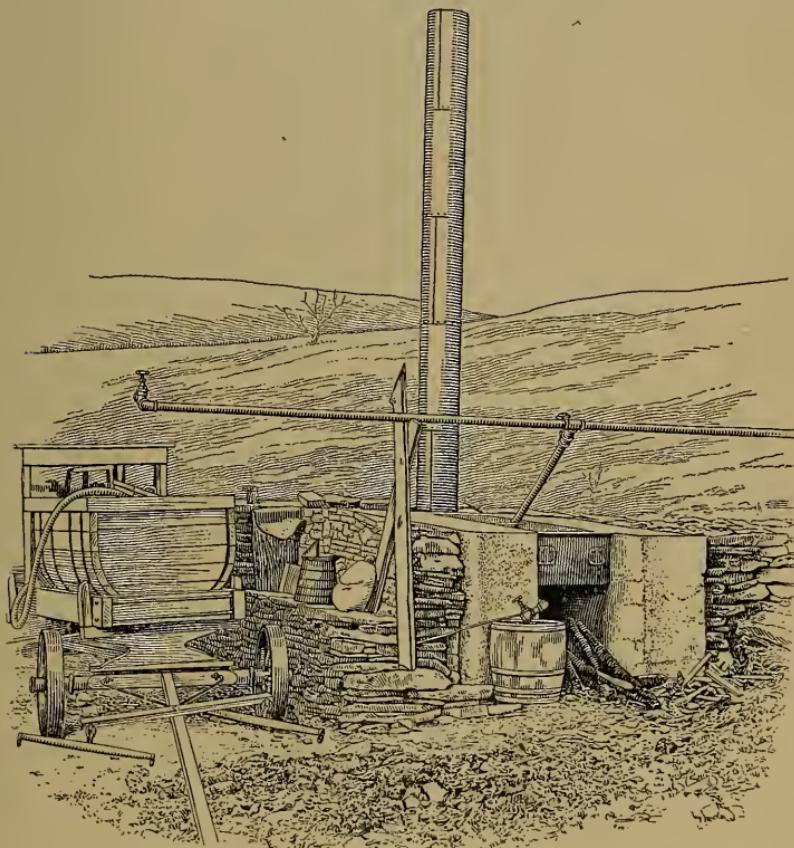


FIG. 8

cement walls. These walls form the sides of the fireplace, and at the rear is a smokestack to give a good draft. The grate in the fireplace is made of iron rods built into the side walls 6 inches above the ground. Fig. 9 is a closer view of the front end of the cooker and shows the fireplace and the pipe connections from the tank to the barrel.

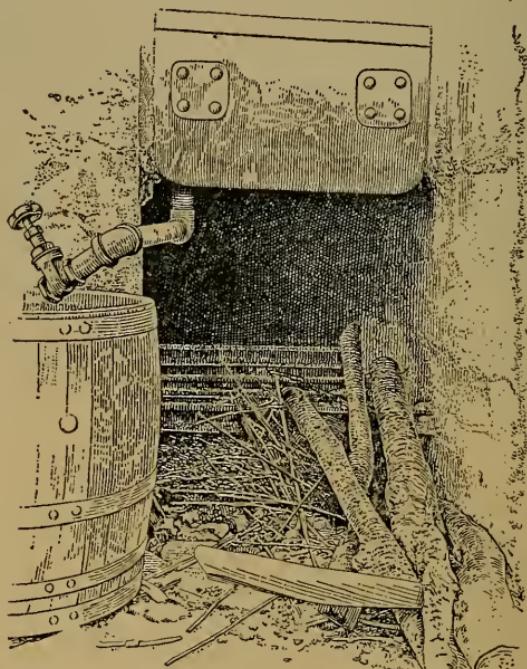


FIG. 9

This cooking plant is of sufficient capacity for boiling 100 gallons of lime-sulphur and was built for \$37. The following is an itemized statement of the cost:

145-gallon sheet-iron tank, second hand.....	\$17.00
Smokestack, second hand.....	5.00
Cement and sand.....	5.00
Labor and sundries.....	10.00
Total	\$37.00

It may be possible in some cases to secure a tank and smokestack for less than the amount named, and the cost of the other items will no doubt vary somewhat with the locality.

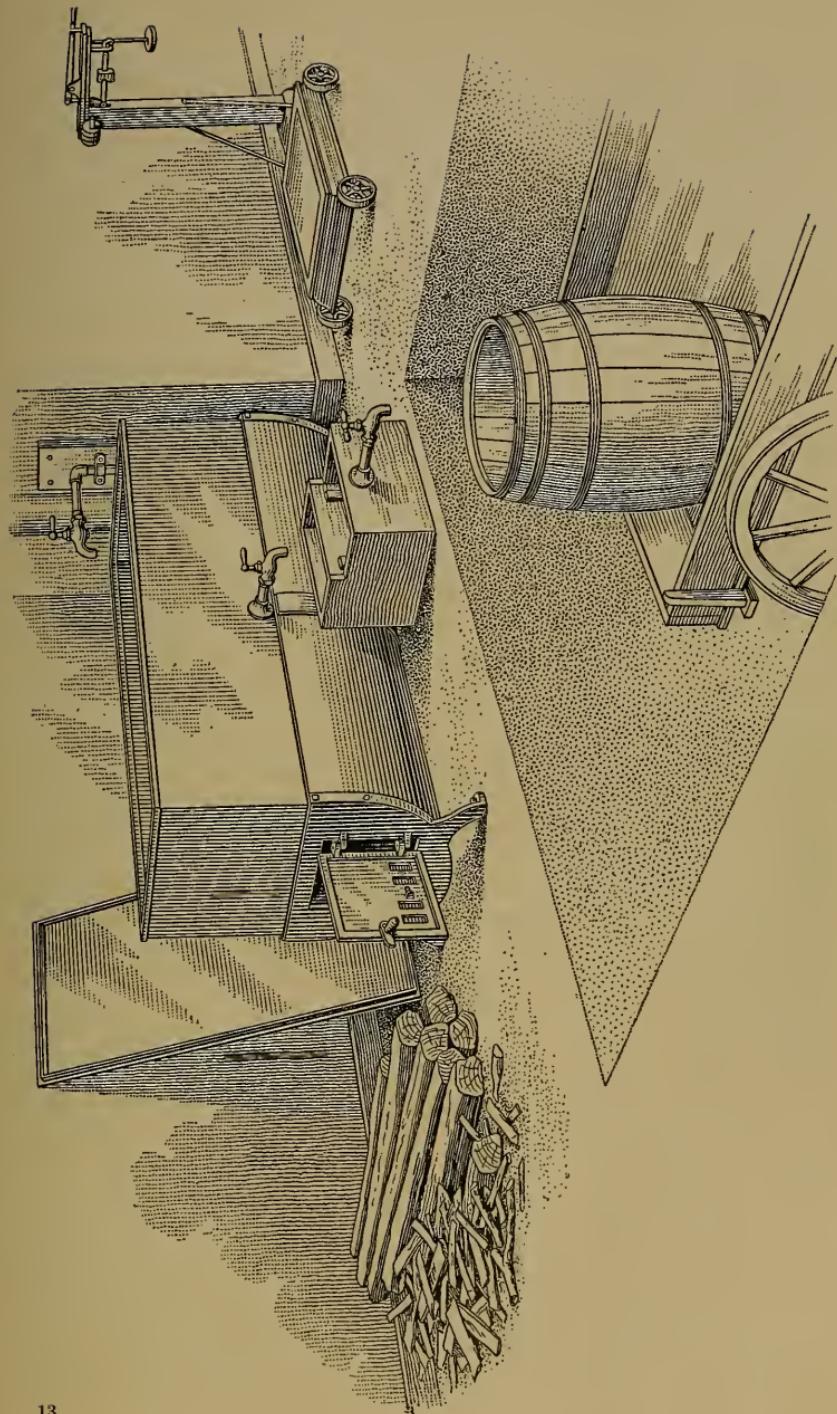


FIG. 10

15. In Fig. 10 is shown a very convenient lime-sulphur cooking plant. This plant is situated on a side hill convenient to the source of water supply, and the arrangement is such that no dipping of water or spray solution is necessary. The bank is excavated in such a manner that a ledge is formed on which the cooking tank, scale, and strainer are set and where wood, sulphur, and lime may be placed convenient for use. The top and sides of the ledge are faced with concrete. A driveway is excavated so that a wagon containing a barrel may be backed up under the strainer faucet. The cooker consists of a cast-iron firebox $5\frac{1}{2}$ feet long and 18 inches high and a boiling tank made of galvanized iron, of the same size as the firebox. In this tank 100 gallons of solution can be cooked at one time.

16. Concentrated lime-sulphur will not freeze at a temperature much above 5° F., and slight freezing does not seem to injure it greatly, especially if the liquid is stirred well before it is used. However, the solution should be protected against severe freezing. When used for spraying dormant trees, lime-sulphur solution should be diluted to a density of about 1.03, although the dilution will vary somewhat, depending on the kind of plants to be sprayed. To determine the quantity of solution to use in a given quantity of water for a spray of the required density, it is necessary to have a hydrometer, an instrument used to measure the specific gravity of liquids. Hydrometers are inexpensive and can be purchased from dealers in orchard supplies. The hydrometer used should be made for liquids heavier than water, and may be secured with what is known as the Baumé scale, with which a table is necessary to find the specific gravity, or may be secured with the specific-gravity readings direct on the scale; the latter type is best for the orchardist.

17. Fig. 11 shows the method of testing the density of a lime-sulphur solution with a hydrometer. The glass *a* is nearly filled with the solution to be tested and the hydrometer *b* on which specific gravity is marked is placed in it. The hydrometer will float and the specific gravity will be shown by the reading of the graduated scale at the surface of the

liquid. The following examples will illustrate the method of procedure in making a solution of any desired density from a more concentrated solution.

Suppose a spray having a density, or specific gravity, of 1.03 is desired, and on testing the concentrated liquid with a hydrometer the specific gravity, or density, is found to be 1.30. The number of volumes of water to be added to form the dilute solution may be found by dividing the decimal part of the number representing the specific gravity of the concentrate, .30, by the decimal of the dilute liquid desired, .03. The result being 10, the concentrate contains 10 times the quantity of combined lime and sulphur that is desired in an equal volume of the dilute solution; therefore, 1 volume of the concentrate must be added to 9 volumes of water. Suppose the specific gravity of the concentrate is 1.27; then, $.27 \div .03 = 9$, and 1 volume of the concentrate must be added to 8 volumes of water.

The division of the decimal to determine the number of times the solution must be diluted is easily explained. The readings of the hydrometer scale gives the specific gravity of the liquid, which is the weight of the liquid as compared with the weight of an equal volume of water. In this comparison the weight of water is taken as unity, or 1. Because lime-sulphur solution is composed only of water and the combined lime and sulphur, a specific gravity of 1.30 means that the .30 represents the combined lime and sulphur in the solution. Since .03 is the amount desired in the dilute solution, dividing the .30 by .03 gives the number of volumes of water that must be added to the concentrated solution to form the required dilute solution.

The dilution for commercial products is generally given on the container, but experience shows that they vary from the figures given, and for this reason it is best to use a hydrometer

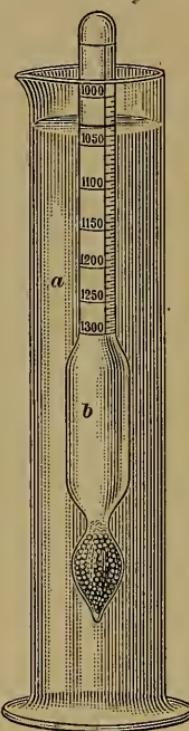


FIG. 11

for testing solutions whether they are home-made or commercial products.

Table I shows the specific gravity of liquids heavier than water for different Baumé degrees up to 36.

TABLE I
COMPARISON OF BAUMÉ AND SPECIFIC GRAVITY HYDROMETER READINGS FOR LIQUIDS HEAVIER THAN WATER

Baumé Degrees	Specific Gravity	Baumé Degrees	Specific Gravity	Baumé Degrees	Specific Gravity
1	1.007	19	1.151	28	1.239
2	1.014	20	1.160	29	1.250
3	1.021	21	1.169	30	1.261
4	1.028	22	1.179	31	1.272
4.3	1.030	23	1.188	32	1.283
15	1.115	24	1.198	33	1.295
16	1.124	25	1.208	34	1.306
17	1.133	26	1.218	35	1.318
18	1.142	27	1.229	36	1.330

18. **Self-boiled lime-sulphur** is a compound used to some extent as an insecticide against oyster-shell scale and other summer scale insects. It is used more largely, however, as a fungicide, and for this reason it will be discussed under the heading Fungicides.

19. After treatment with certain chemical substances, certain oils may be combined with water to make a uniform mixture. Oils that have been so treated are known as **miscible oils**, and in combination with water are used extensively as contact insecticides. There are a large number of brands of miscible oils on the market, most of which will prove satisfactory to the orchardist. When water is added to some of these commercial miscible oils, a milk-white emulsion is obtained; in other cases, a dark emulsion. It is very easy, however, to determine in all cases whether or not there is a good mixture: if any of the oil comes to the top it shows that

part of the oil is not combined with water. Such a mixture should never be used, as the uncombined oil is very likely to injure the trees. The average fruit grower should purchase miscible oils ready made, as the making of these oils is attended with considerable difficulty. However, if the orchard to be sprayed is very large and the manager has some chemical knowledge, it may be economical to make the miscible oil.

20. For convenience in the discussion of the making of miscible oil, the term emulsifier will be applied to the chemicals used to bring the oil into such a condition that it will mix with water; the oil after being chemically treated will be termed the miscible oil, and the combination of the miscible oil and water will be termed the emulsion.

The materials and directions for making the emulsifier are as follows: Liquid crude 100-per-cent. carbolic acid, 2 quarts; menhaden fish oil, $2\frac{1}{2}$ quarts; granulated caustic potash, 1 pound. Heat to 300° F., remove from the fire, and immediately add $3\frac{1}{2}$ quarts of kerosene and 5 quarts of water. These quantities will make about 3 gallons of emulsifier, which is sufficient to make from 19 to 20 gallons of miscible oil. The carbolic acid, fish oil, and caustic potash should be placed in a kettle and the fire started. The mixture requires stirring until the potash is thoroughly dissolved. A cover should then be placed on the kettle to prevent loss from evaporation. An iron kettle is suitable for making the emulsifier. It should have a cover, which may be of wood or metal with a small opening that will accommodate a perforated

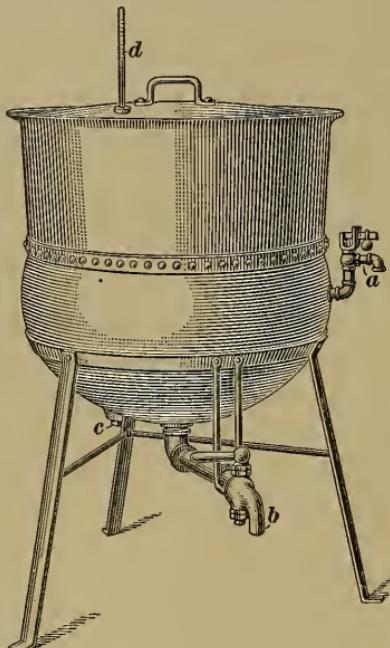


FIG. 12

stopper through which a thermometer can be inserted into the liquid and kept in place. A special thermometer graduated to read as high as 300° F. must be used, and the temperature should be brought very gradually from around 260 degrees to 270 degrees, since at this point the mixture tends to foam badly. If steam under 60 pounds pressure is available, the mixture may be boiled in a jacketed kettle similar to the one shown in Fig. 12. The steam is allowed to enter through the pipe *a* into the jacket that surrounds the kettle; the liquid after being boiled may be let out from the kettle through the faucet *b*; a vent for drawing off the condensed steam is shown at *c*; *d* is a thermometer inserted through the hole in the cover.

The emulsifier should never be made near a building, as the mixture is inflammable when hot and the carbolic acid gives off disagreeable fumes. When a temperature of 300° F. is reached, the kettle should be removed immediately from the fire, or the fire should be quickly quenched with sand or soil. The hot mixture may then be transferred to a larger vessel and the kerosene added at once and then the water. It is dangerous to add the water before adding the kerosene, and the temperature of the mixture should not be higher than 212° F. when the water is added, or steam will form and throw the liquid out badly. This emulsifier will remain in a good condition indefinitely.

21. The second part of the process of making miscible oil does not require the application of heat. A moderately warm day should be selected so that the oil will not be too thick, and if possible the emulsifier should be placed in a warm room for a day or two before being mixed with the oil. The emulsifier should be thoroughly stirred and the ingredients of the mixture brought together in the following order: Emulsifier, 8 parts; paraffin oil, 35 parts; rosin oil, 5 parts; water, 1 part. This mixture should be vigorously stirred; if there is a large quantity, a garden hoe will be found convenient as a stirrer. At first the mixture appears thin, but becomes thicker as it is stirred; when smooth, it should be tested by pouring a few

drops in a glass of water; a milk-white appearance resulting indicates a satisfactory miscible oil. If the milk-white appearance does not result, the stirring should be continued.

All that is necessary in order to form the emulsion for spraying is to add water to the miscible oil. To make a spray solution for use when the trees are dormant, from 10 to 15 parts of water should be used with 1 part of oil; and for a summer spray, 25 to 40 parts of water to 1 part of oil should be used.

22. Kerosene emulsion, an insecticide similar in nature to miscible oil, is made from kerosene with soap as an emulsifier. The most suitable soap for this purpose is either whale-oil soap or some vegetable soap, although common laundry soap will suffice. The following formula is most generally recommended for kerosene emulsion: Hard soap, 1 pound; kerosene, 2 gallons; soft water, 1 gallon. The soap should be cut into fine pieces and thoroughly dissolved by heating in the gallon of soft water. The vessel of boiling soap solution should be removed far enough from the fire that there will be no danger of explosion, and the 2 gallons of kerosene added with a small spray pump that has the nozzle arranged to throw a stiff stream. After all the kerosene has been added, the pump should be placed in the vessel containing the mixture and a stiff stream should be pumped back into the solution until the liquid is thoroughly emulsified. After a few minutes of agitation the liquid begins to have a milky appearance and at last thickens to a butter-like mass, in which condition it will remain for a considerable length of time. This stock solution should be diluted with 17 gallons of water for use as a spray. If the weather is cold, the stock solution may not mix readily with water, but can be made to mix by warming. Pumps used for spraying kerosene emulsion should have metal or marble valves, since the oil destroys rubber valves very quickly.

23. Distillate oils are used considerably as insecticides in the western part of the United States. Distillates are made from oil taken from wells in the West, and those commonly used for spraying have a specific gravity of .89, or

28° Baumé for liquids lighter than water, although occasionally those having a specific gravity of .90, or 26° Baumé, are used. It is well to explain here that there are two Baumé scales, one for liquids heavier than water and one for liquids lighter than water.

These oils are used as insecticide sprays in two forms; in the form of an emulsion and in the form of a mechanical mixture. Emulsions are made in the same way that kerosene emulsion is made, but more water is used for diluting. One formula for the emulsion is: soap, $\frac{1}{2}$ pound; water, 1 gallon; oil, 2 gallons; when these are thoroughly emulsified, 30 gallons of water is added. However, the distillate oils do not emulsify so readily as kerosene, and for this reason they have not proved entirely satisfactory when applied in the form of an emulsion.

The mechanical mixture is made by rapid and thorough agitation of the oil and water in the spray tank or barrel at the time of spraying. This agitation breaks the oil into fine particles and mixes it with the water, producing a spray that has a milky appearance. The use of this mixture is also attended with some danger unless used in a very dilute form, as the oil will sometimes enter the stoma of the leaves or a place where an injury to a leaf has occurred and from such places will penetrate and kill the surrounding cells. It has been found in California that a stronger spray can be used on the upper side of the leaf than on the lower side. In that state, since the scale, which is hard to kill, is located on the upper side of the leaf, and the red spider, which is easily killed, is located on the under side of the leaf, it has been found practical to spray the upper side of the leaf with a strong mixture of distillate, and at the same time to spray the lower side of the leaf with a solution in which twice as much water is used. The upper side of the leaf should be sprayed with what is known as the undershot nozzle—that is, a nozzle that directs the spray altogether downwards; and for the under side of the leaf a nozzle that directs the spray upwards should be used. It is possible to have a pump so arranged that two spray liquids containing different percentages of oil can be sprayed at the same time, and thus with the same sprayer one man can be

using an undershot nozzle that throws the strong spray mixture and another be using an uppershot nozzle that throws a weaker spray mixture.

24. Tobacco extracts and decoctions are good sprays for use against plant lice and some other sucking insects, provided they contain a large proportion of tobacco. Many proprietary tobacco decoctions are on the market and these, when applied in accordance with the directions that accompany the package, will no doubt prove more satisfactory than decoctions made at home. It is possible, however, to make a tobacco decoction at home that is reasonably good. For making this decoction, tobacco stems or tobacco refuse may be used; 1 pound of tobacco should be placed in 1 gallon of cold water and the water heated to the boiling point and boiled for a few minutes. After cooling and straining, the decoction is ready for use.

FUNGICIDES

25. Diseases of plants result from the growth of fungi, which are small plants that feed upon the tissue of larger plants. The sprays used for controlling the growth of fungi are known as **fungicides**. These sprays will not kill fungi after they have secured a firm footing on a plant, but are effective in killing the germinating spores, which are the reproductive bodies of fungi and correspond to the seeds of higher plants. Therefore, to be of any benefit, the fungicides must be applied before or at the time of germination of the spores.

Solutions containing some form of copper are among the most valuable fungicides in use at the present time. It has been found that as small a quantity as 1 part of copper to 400,000 parts of water will entirely prevent the germination of the spores of certain fungi, and until recently practically all of the fungicides used contained copper. However, copper in a soluble form is very injurious to foliage and fruit, and, as it is difficult to make a spray solution containing copper in which none of the copper is in a soluble form, more or less injury is often done by these sprays. For this reason sprays

that do not contain copper have been in demand by fruit growers during recent years for use as fungicides, and a number of such sprays are now used to a considerable extent. Most of the fungicide sprays that do not contain copper have some form of sulphur in their composition. These have been found to control many fungous diseases very satisfactorily without injuring fruit or foliage. There are, however, a few fungous diseases that, up to the present time, have not been successfully controlled by any spray that does not contain copper.



FIG. 13

26. Bordeaux mixture is the most important and best-known fungicide in use at present. It is made of water, lime, and copper sulphate, which is sometimes called bluestone, or blue vitriol, enough lime to precipitate all of the copper sulphate being used. Bordeaux mixture was first discovered by Professor Millardet, of Bordeaux, France; hence the name. A mixture of lime and bluestone had been applied to grapes along

the roadway to keep the passers-by from bothering them. Some of this was sprinkled on the leaves and it was found that these leaves did not become diseased and fall off as did the leaves on the rest of the vines. Professor Millardet, observing this, began to experiment with a mixture of copper sulphate and lime as a fungicide and discovered the valuable qualities of the spray that has since been known as Bordeaux mixture.

The following formula is one often used for making Bordeaux mixture to be used as a spray for trees that are dormant: Copper sulphate, 6 pounds; fresh stone lime, 6 pounds; water, 50 gallons. The following formula is recommended when the spray is to be used on fruit trees during the time they are in foliage: Copper sulphate, 3 pounds; fresh stone lime, 3 pounds; and water, 50 gallons. The first of these is known as a 6-6-50, and the second as a 3-3-50 Bordeaux mixture.

27. The first step in making Bordeaux mixture is to prepare stock solutions of copper sulphate and of lime which may be kept indefinitely. Fig. 13 represents a simple plant that may be easily constructed for making Bordeaux mixture. The platform *a* should be of sufficient height that the spray tank may be driven under the strainer *b* for filling. The barrels shown are kerosene barrels holding 50 gallons. To make the stock solution of lime, 50 pounds of good stone lime should be placed in the barrel *c* and sufficient water added to slake the lime and form a thin paste. When the lime is thoroughly slaked the barrel should be filled with water and the contents thoroughly stirred. The liquid will then contain 1 pound of lime to 1 gallon of water.

28. To make the stock solution of copper sulphate, the barrel *d* should be filled with water and 50 pounds of copper sulphate should be placed in a burlap bag and be suspended in the water near the surface, where it will dissolve in about a day. If the copper sulphate is placed in the bottom of the barrel it will not dissolve for many weeks. When it is all dissolved the solution will contain 1 pound of copper sulphate to 1 gallon of water.

To make the dilute solution, used for spraying, from these stock solutions is a very simple matter: After thoroughly stirring the stock solution of lime in barrel *c*, 6 gallons for the dormant spray mixture, or 3 gallons for the summer spray mixture, should be transferred to barrel *e* and water added to half fill the barrel, making 25 gallons of the solution. In barrel *f* should be placed either 6 gallons or 3 gallons of the copper-sulphate solution, depending on the spray required, and water added to half fill the barrel, making 25 gallons of the copper-sulphate solution. These two solutions should now be allowed to run together through the strainer *b* into the spray barrel or tank and will form 50 gallons of mixture ready for use. To connect the barrels with the strainer a $1\frac{1}{2}$ inch hole may be bored into the barrels near the bottom and pieces of gas pipe about 6 inches long, inserted and connected with the strainer by pieces of rubber hose. When desired to prevent the liquid from flowing from the barrels, the open end of the rubber hose may be placed in the top of the barrel, or a spigot may be used in place of the gas pipe.

The copper sulphate and the lime solutions should not be combined until just before the spray is to be used, as the mixture is unsatisfactory after it stands for a considerable time.

29. Bordeaux mixture before being applied should be tested to make sure that enough lime has been used. This test is made by taking a small sample of the Bordeaux mixture and adding a few drops of potassium ferrocyanide. If no change in color takes place there is sufficient lime in the mixture; if a brownish color is shown more lime should be added. Potassium ferrocyanide may be purchased from any druggist, but it is a deadly poison and must be handled with caution. Ten cents worth dissolved in a pint of water will be enough to test all of the Bordeaux mixture ordinarily required in a season. Another and more simple method of testing Bordeaux mixture, although one that is possibly not so accurate as that just given, is simply to hold a clean, bright knife blade in the mixture for at least 1 minute. If the blade, on removal from the liquid, shows a trace of copper color, more lime should be added. Bordeaux

mixture may be easily and completely cleaned from the hands by the use of a little vinegar.

30. During past years great damage has been done to the apple crop by the use of Bordeaux spray. If there is any copper uncombined with lime in the solution, serious injury will be caused to the leaves, which are turned brown by the copper. There is more liability to this injury if the mixture is applied during damp weather than if the weather is dry. It has also been claimed that Bordeaux mixture sometimes causes leaves to turn yellow. Serious injury has also been done to the fruit by causing the russetting of apples, which is the result of a corky tissue forming to heal spots where the skin was killed by the mixture. It is thought that this injury occurs while the apples are small and still retain plant hairs; a weak solution consisting of 2 pounds of copper sulphate, 3 pounds of stone lime, and 50 gallons of water has therefore been recommended for the first two sprayings of apples.

31. **Ammoniacal copper carbonate** is a solution sometimes used as a fungicide with fairly good results. It is made from copper carbonate, 6 ounces; ammonia of about .90 specific gravity, or 26° Baumé, 3 pints; water to make 50 gallons. The copper carbonate is dissolved in the ammonia and the solution kept in a tightly corked bottle or jar until needed. For spraying, the solution is made up to 50 gallons by the addition of water. This solution does not stain fruit as Bordeaux mixture does and for this reason its use on ripe fruit, especially in the case of bitter rot of apples, may sometimes be advisable; but it is much more injurious to the tree than Bordeaux mixture, and is not so effective.

32. **Copper-sulphate solution** consisting of from 1 to 3 pounds of copper sulphate to 50 gallons of water is sometimes used as a fungicide spray. This is not a desirable spray for fruit plants, since it is very injurious to foliage; however, it does not leave any stain on the fruit.

33. **Sulphur dust** is another substance that has considerable value as a fungicide. This dust is used to combat powdery mildew of some fruits and also some other plant diseases.

34. **Potassium sulphide** is sometimes used in a spray that is of some value as a fungicide. The spray is made by dissolving potassium sulphide, sometimes called liver of sulphur, in water, at the rate of 1 ounce to 2 gallons. This solution deteriorates rapidly and should not be prepared until needed for spraying. It is of value principally for powdery mildew on berry plants.

35. **Lime-sulphur**, which has been discussed under the heading Insecticides, is being used as a summer fungicide to replace Bordeaux mixture. It is used at a strength indicated by a specific gravity of from 1.007 to 1.01, or from about 1 to $1\frac{1}{2}^{\circ}$ Baumé, the exact dilution depending on the kind of plant to be sprayed. It should always be carefully tested with a hydrometer. The number of times it is necessary to dilute the concentrate solution is found in the same way as for the insecticide. Lime-sulphur as a fungicide has the advantage over Bordeaux mixture that it does not cause russetting of fruit. Lime-sulphur has been found to control apple scab about as well as Bordeaux mixture, but does not control either apple blotch or bitter rot.

Although lime-sulphur is less injurious than Bordeaux mixture, it has shown some injurious effects, especially to foliage, and should never be used as a fungicide with a specific gravity greater than 1.01. Although lime-sulphur is a promising fungicide spray, it cannot be unhesitatingly recommended until it has been used longer. Bordeaux mixture was used for a number of years before injury to fruit was observed and it may be that succeeding seasons will tend to bring conditions resulting in greater injury from the use of lime-sulphur than so far observed.

36. **Self-boiled lime-sulphur** has in recent years come into general use as a fungicide. This material is especially valuable for spraying peaches and has some value also as a

spray for some other fruit. It is merely a mechanical mixture of lime and sulphur, only an exceedingly small quantity of the sulphur being in solution. In making the mixture, no heat is applied except the heat of the slaking lime. The mixture is practically harmless to fruit and foliage.

Different quantities of lime and sulphur have been recommended for making this mixture, but in all probability a strength of 6 pounds of sulphur, 6 pounds of lime, and 50 gallons of water is most desirable; in case of a very serious infestation of fungus 8 pounds of sulphur, 8 pounds of lime, and 50 gallons of water may be used.

This mixture can best be prepared in rather large quantities, say enough for 200 gallons of the spray. The required quantity of lime, for example, 24 pounds, is weighed, placed in a barrel, and enough water to nearly cover it is poured in. The same quantity of sulphur should have been previously weighed and sifted, and when the lime begins to slake well the sulphur is added and the mixture thoroughly stirred; water is added as fast as possible without reducing the vigor of the slaking. A hoe will be found convenient for use in stirring the compound. The mixture will at first be a thick paste, but water should be gradually added until a thin paste is formed. As soon as slaking ceases, enough water to cool the mixture is added. This stops all further change and is very important, since, if it is neglected, chemical combination may continue until injurious compounds are formed. Cold water should be used for slaking the lime. When cool the mixture is ready to be strained into a spray tank and diluted with water to the required 200 gallons. A mixture of the strength given is practically harmless to foliage when the directions given are followed; it is very effective for spraying peaches, because the down of the peach holds the mixture on the fruit; it is not so effective for spraying smooth fruit, since the mixture is rather coarse and is readily washed off by rain.

COMBINED INSECTICIDES AND FUNGICIDES

37. The season when the most common orchard diseases must be combated is also the season for combating the most serious summer orchard insect pests, and it is possible to combine insecticides and fungicides and make the one spraying answer for both purposes. If fungicides and insecticides are combined they should be known to have no injurious chemical effect on each other. Experience has proved that Bordeaux mixture and the most common poisonous insecticides, arsenate of lead, Paris green, arsenite of soda, and arsenite of lime, may be combined without making either the fungicide or the poison more injurious to the foliage or less effective. In combining arsenite of soda and Bordeaux mixture, it is not necessary to add the excess of lime that is added when arsenite of soda is used without Bordeaux mixture, since the Bordeaux contains excess lime. When lime sulphur is combined with the arsenate of lead, it has been found by laboratory experiments that both the lime-sulphur and the arsenate of lead change in composition rapidly. However, by experience in the orchard it has been found that this combination spray is less injurious to foliage than is lime-sulphur alone, although the efficiency of the arsenate of lead seems to be somewhat reduced. Lime-sulphur combined with Paris green has been used as a spray in a few cases and no injurious results observed, but the combination has not been used enough to justify positive conclusions. Experience in the orchard has proved that lime-sulphur combined with arsenite of lime is much more injurious than lime-sulphur combined with arsenate of lead. In fact, arsenate of lead is the only poisonous insecticide that can be fully recommended for combination with lime-sulphur.

SPRAYING MACHINERY

38. Many forms of spraying outfits, from the small knapsack sprayer to be carried on the back of the operator to the power outfit or even the large central compressed-air outfit are on the market. Each type of sprayer will be discussed separately; the accessories, such as hose, nozzles, etc., will be discussed under one heading, since the description will apply to accessories for any form of sprayer. It may be said that in all spraying apparatus the parts with which Bordeaux mixture, ammoniacal copper carbonate, or other copper sprays come in contact should be lined with brass or enamel or should be of wood, since the copper corrodes iron or other metals. No part of an outfit that is to come in contact with lime-sulphur should be made of copper.

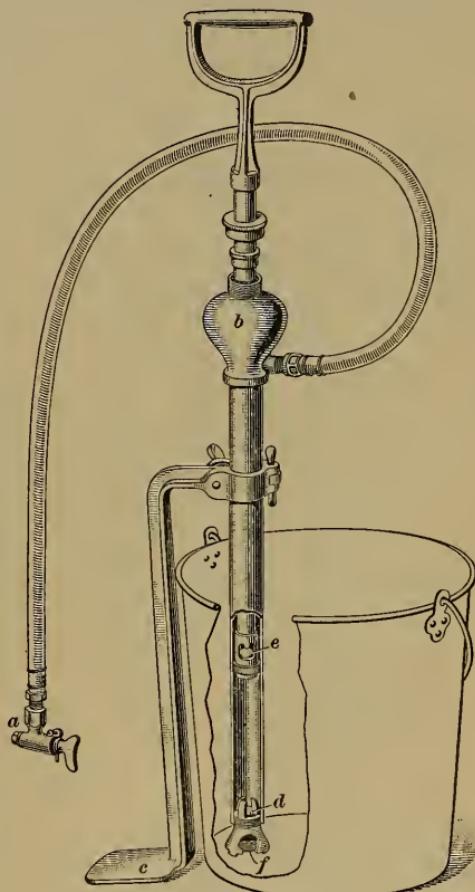


FIG. 14

HAND SPRAYS

39. Bucket Spray Pump.—For a few small trees or bushes, a bucket spray pump, a type of which is shown in Fig. 14, may be used. This pump has a removable nozzle *a* and is made entirely of brass and has a small air chamber *b* that helps to equalize the pressure and cause the spray to flow more steadily. The foot rest *c* helps to hold the pump while it is being operated. A part of the pump is shown removed,

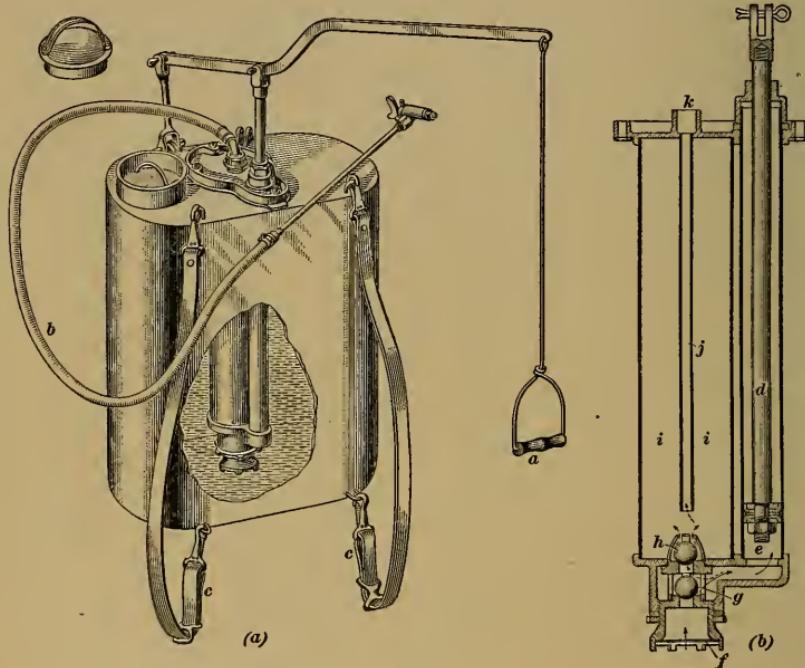


FIG. 15

exposing the lower valve *d* and the valve *e* in the plunger. Both of the valves are made of brass. A strainer shown at *f* is placed in the bottom of the pump to prevent the entrance of particles that would injure the pump or clog the nozzle.

40. Knapsack Sprayer.—The outfit illustrated in Fig. 15 consisting of a brass force pump surrounded by a copper or a galvanized-iron tank, is known as a knapsack sprayer, and may be used for small trees or bushes. The tank holds

about 5 gallons and is made to fasten to the back by means of the straps *c*. The material of which the tank should be made depends on the spray solution to be used. If lime-sulphur is to be used, the tank should be of galvanized iron, as the solution will very quickly destroy copper. If Bordeaux mixture is to be used, the tank should be of copper, as the Bordeaux mixture has a somewhat injurious effect on iron. The tank is shown in (*a*) with a portion broken away to expose the pump to view. The pump is operated by means of the handle *a*, which is attached to the lever extending forwards over the shoulder, as the outfit is carried on the back. The pump is operated with one hand, and the spray rod, with nozzle, attached to the hose *b* is controlled with the other hand. In (*b*) is shown a sectional view of the pump removed from the tank. As the plunger *d* is raised the liquid is drawn up into the chamber *e* through the strainer *f*, the ball valve *g* being forced up and allowing the liquid to pass through. As the plunger is moved down the valve *g* closes and the liquid is forced up through valve *h* into chamber *i*. As the pumping continues and more liquid is forced into chamber *i* the air in the chamber is compressed and a steady stream of liquid is forced by the pressure out through tube *j* and through the spray hose, which is attached at *k*. The nozzle shown attached to the spray rod at the end of the hose may be removed and any other form of nozzle desired may be substituted.

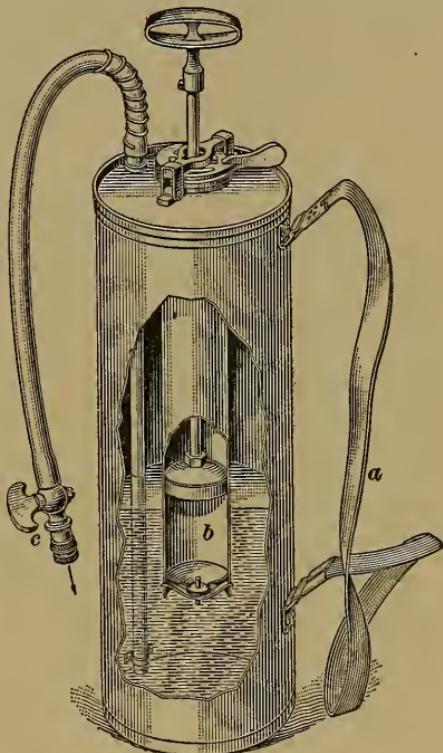
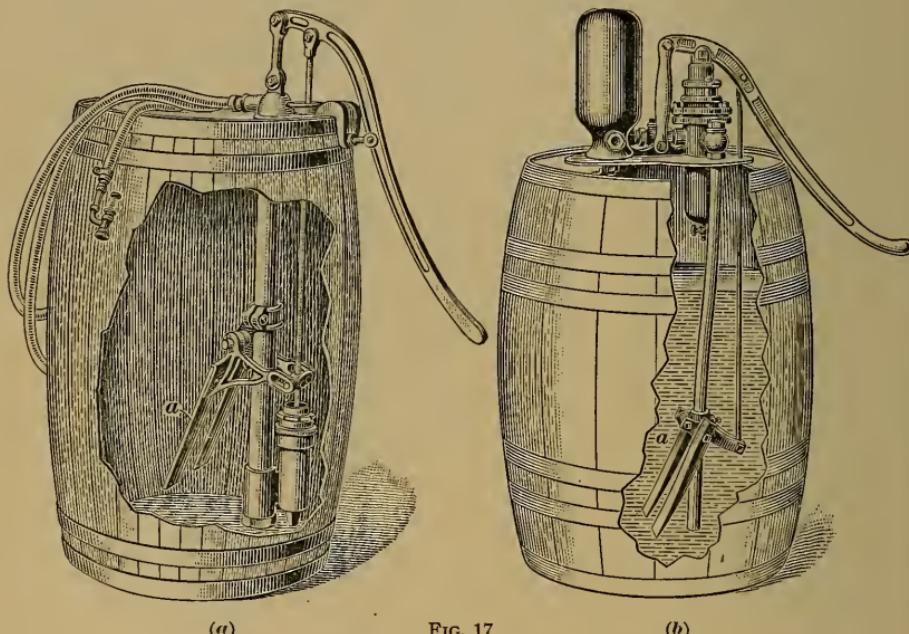


FIG. 16

41. Compressed-Air Hand Sprayer.—A convenient form of small sprayer is shown in Fig. 16. This is a compressed-air hand sprayer made to be carried by means of a strap *a* placed over the shoulder. The sprayer holds about 4 gallons and after being nearly filled with the spray solution air is pumped in on top by means of the air pump *b*, which works on the same principles as a bicycle pump. The spraying may then be done by simply opening and closing the shut-off at the nozzle until the air pressure is exhausted, when more air must be pumped in.



42. Barrel Sprayers.—Two very satisfactory types of hand sprayers for use in small orchards are illustrated in Fig. 17 (a) and (b). These are known as barrel sprayers. The pump, which should be of good workmanship, is mounted on a good-sized barrel in which the spray solution is placed. These barrel sprayers may be mounted on a wagon or sled as preferred. The type shown in (a) has all of the heavy parts of the pump in the barrel and is not so easily upset as the type shown in (b), which has the pump and air chamber on top.

(c)

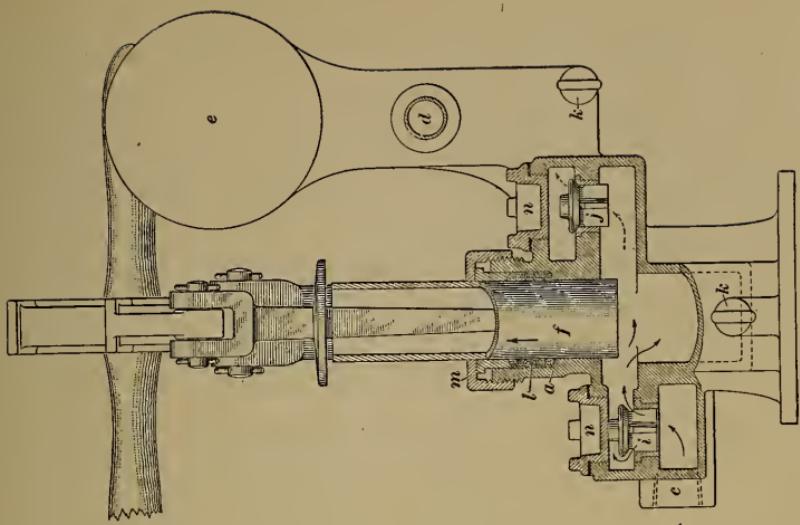
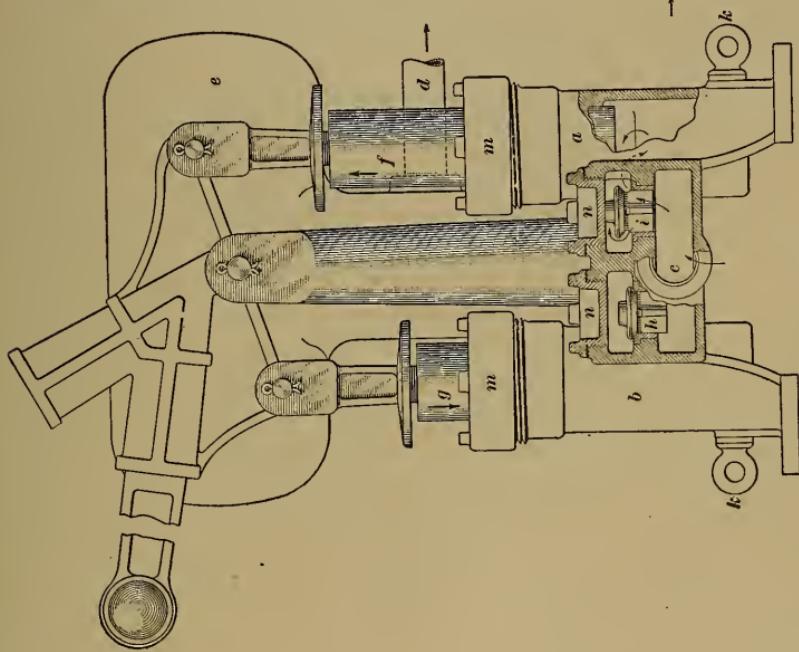
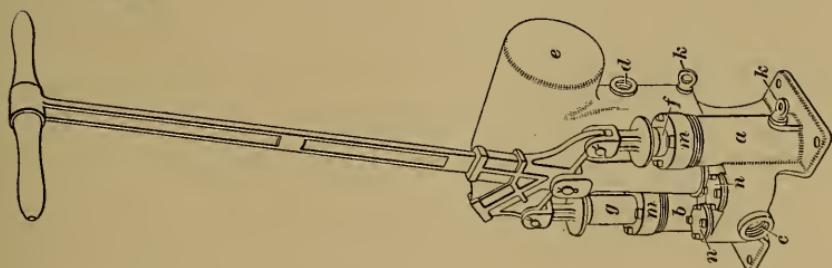


FIG. 18
(b)



(a)



43. Double-Action Spray Pump.—Fig. 18 shows a double-action spray pump to be used with a tank or large barrel. This pump has a long leverage and for this reason is more satisfactory than barrel sprayers of large capacity when much spraying is to be done. View (a) shows the entire pump, which has two cylinders *a* and *b*. The spray solution enters the pump from the barrel or tank through a hose attached to the inlet *c* and is discharged through the spray hose attached to the outlet *d*; an air chamber *e* equalizes the pressure and causes a steady flow of the liquid. View (b) is an enlarged view of the pump with part of the outside removed to expose to view some of the valves and the lower part of one of the pistons. As the piston *f* rises the piston *g* descends, the valve *h* closes, and the valve *i* opens, allowing the liquid to flow into the cylinder *a*. As piston *g* rises and piston *f* descends, valve *h* opens, allowing the liquid to flow into cylinder *b*, and valve *i* closes, preventing the liquid in cylinder *a* from flowing back through the inlet. A sectional view of cylinder *a* is shown in (c). When the piston *f* descends the valve *i* closes, the liquid is forced up through valve *j* into the lower part of the chamber *e*, and when the piston *f* rises as shown in the illustration, valve *j* closes, preventing the liquid from passing back out of chamber *e*. As the pumping continues and more liquid is forced into *e* the air in the chamber is compressed and causes a steady stream to flow out through the hose attached at *d*. Plugs, which should be removed to allow the liquid to drain out of the pump after spraying, are shown at *k*. The packing around the piston that prevents leakage is shown at *l*. This may be replaced by removing the cap *m* and may be tightened by turning the cap down. Caps that may be removed to give access to the valves are shown at *n*.

POWER SPRAYERS

44. Traction Sprayer.—The simplest form of power sprayer is one in which the pump is operated by power transmitted from the wheels of the truck by means of cams, eccentrics, chains, or gears. The pump has nearly always a large compressed-air chamber so that the power may be accumulated for times when the truck is not moving. Traction

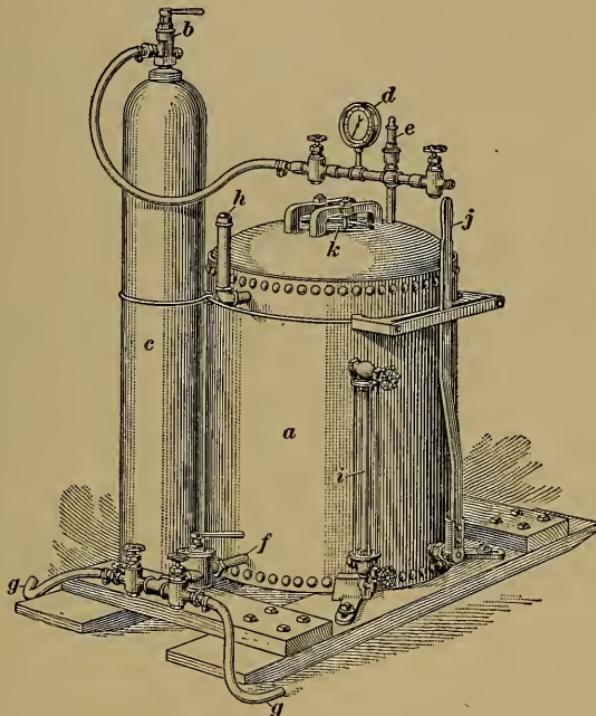


FIG. 19

sprayers are often used in vineyards and are very satisfactory for spraying certain truck crops, but they have not proved entirely satisfactory for orchard work; one of the reasons for this is that the size of orchard trees varies so much that there can be no certainty as to whether or not the movement of the truck will be great enough to generate sufficient power for spraying during the time the outfit is standing still.

In purchasing a machine of this kind, it should be carefully examined in respect to workmanship, because only a good one will give satisfactory results.

A traction sprayer is illustrated in Fig. 13.

45. Gas-Power Sprayer.—In one class of sprayers the power for producing the spray is furnished by compressed carbon-dioxide gas, which may be procured from supply houses in metal drums such as are used in bottling works. The spray

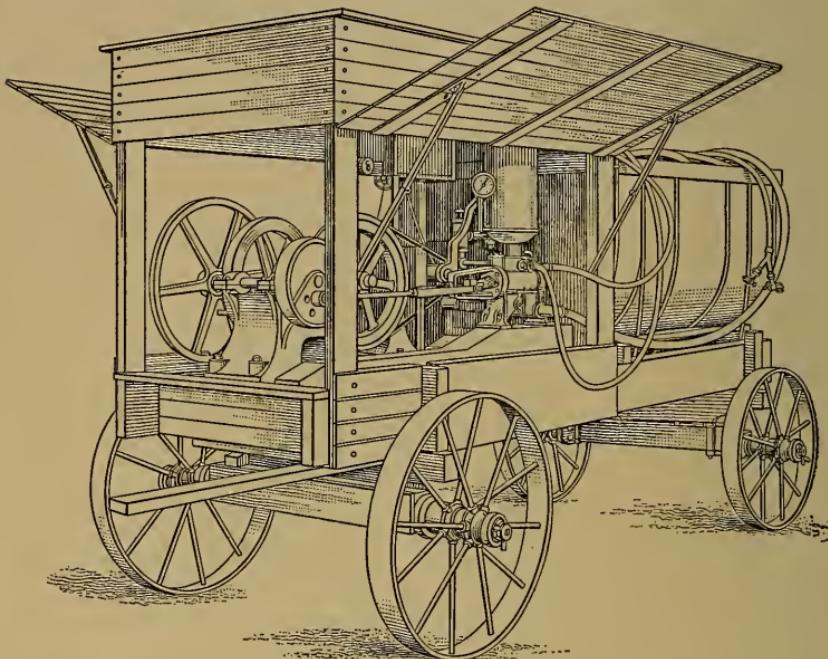


FIG. 20

tank used with one of these outfits must be air-tight to retain the gas, which enters the spray tank from the long drum shown in Fig. 19. This outfit can be mounted on a light wagon and is very easily operated, since all that is necessary to keep up the pressure in the spray tank *a* is to turn the valve *b* and let in gas from the drum *c* until the desired pressure is reached, as shown by the pressure gauge *d*. The safety valve *e* allows the gas to escape and thus prevents bursting of the tank in case too much is admitted from the drum. The spray solu-

tion is forced out through pipe *f* and into the hose *g*. The pipe *h* may be opened for filling the tank with the solution. The gauge glass *i* indicates the height of the liquid in the tank. The handle *j* is attached to an agitator in the bottom of the tank by means of which the liquid is kept stirred. By removing the cover *k* the tank may be cleaned.

An advantage of the gas-power sprayer is that it is very simple in construction, is light, and can be used in places where it is difficult to use a gasoline-power sprayer. However, because of the cost of the gas, it is somewhat expensive to operate. When an outfit of the type shown is used for spraying

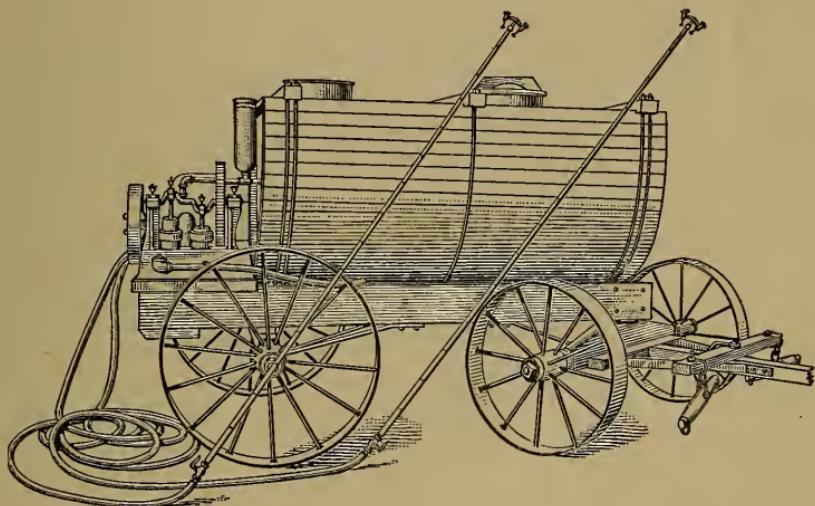


FIG. 21

lime-sulphur combined with arsenate of lead, the passage of the carbon dioxide through the mixture precipitates some of the lime and also seems to cause a change of the arsenate compound in the mixture that may produce injurious effects.

46. Gasoline-Power Sprayers.—For full-bearing orchards of 15 acres or more, gasoline-power sprayers, two types of which are shown in Figs. 20 and 21, have generally given the best satisfaction. As the name would indicate, the power for these sprayers is furnished by a gasoline engine. The structure of gasoline engines cannot be discussed here; how-

ever, in buying a gasoline outfit the construction of the engine should be carefully examined and the purchaser should be certain that it is durable before buying. Since the engine must be hauled around, generally, with one team, it is important that it be reasonably light, and durability may be sacrificed to lightness to some extent. It should not be assumed, however, that a heavy engine is always more durable than a lighter one, since workmanship figures very largely in the durability of engines.

In spraying with a gasoline engine, probably two of the most essential though the simplest items of care are to keep all parts,

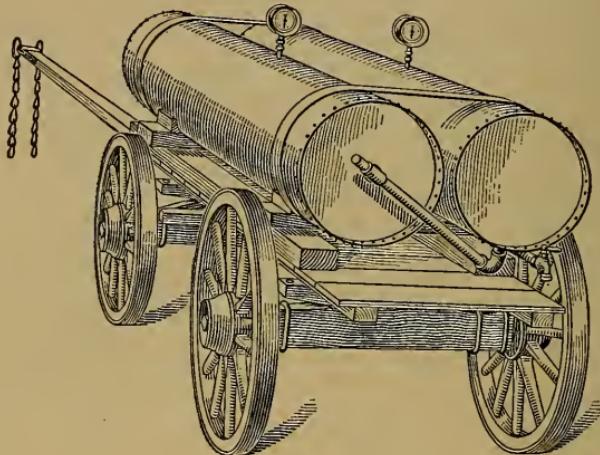


FIG. 22

especially the cylinder, oiled with good oil, and to keep all the bolts tight. The small engines generally used with spraying outfits must run rapidly and if any bolts are loose the engine is rapidly worn. In case the engine fails to work, the batteries should first be tested to see whether the spark produced is sufficient to ignite the gasoline. The gasoline tank should next be examined to see whether it is empty. Then the spark plug should be examined, for it often becomes gummed or soaked with oil, and instead of a spark being produced, a continuous current is given that does not ignite the gasoline. The gasoline used should be perfectly pure, as the presence of water or dirt in the gasoline gives much trouble. When

back-flaring—that is, an explosion with a jet of flame from the carbureter—occurs, there is not a proper mixture of air and gas, or the spark occurs at the wrong time. An improper mixture is also indicated by smoking; in this case there is not enough air.

47. Compressed-Air Sprayer.—A type of compressed-air sprayer that involves the same principle as that of the gas-power sprayers is illustrated in Fig. 22. The air compressed in one tank is admitted to another containing the spray solution, and forces the solution out through the spray hose. The air is compressed at a central plant, usually with a large gasoline engine. The great difficulty with this type of sprayer is insufficient agitation. In some of the compressed-air sprayers, no provision is made for agitation, and in others the air is admitted to the spray tanks in jets that will stir the liquid; and in still others the tank containing the liquid is above the one that contains the compressed air, so that before the liquid is sprayed out it must run down from the liquid tank into the air tank, thus giving considerable agitation if the liquid is sprayed out rapidly. This type of sprayer has advantages only where large orchards are to be sprayed, in which case only one engine is necessary to compress the air to do the spraying rather than several engines, as would be necessary in case gasoline-power sprayers were used. The engine for compressing the air can naturally be larger and generally of a type that will give less trouble than in the case of the gasoline-power sprayers, and the plant will be large enough that a man who is something of an expert with gasoline engines can be employed to run the engine while at the same time he looks after the mixing of spray solution. However, added to the difficulty of agitation is another important disadvantage; that is, with one large gasoline engine compressing air for a number of sprayers, should the engine get out of order all of the spraying must stop, while if the work were being done with separate gasoline-power outfits, an engine out of order would interfere with the work of but one outfit. In general, compressed-air outfits have not been found satisfactory.

ACCESSORIES FOR SPRAYING OUTFIT

48. Nozzles.—The nozzle is one of the most important items of a spraying outfit. During the past 15 or 20 years great change in the adjustment of nozzles has taken place, and only three types of nozzles most used at the present time are discussed here. The nozzle probably longest in use of these three is the **Bordeaux nozzle**, illustrated in Fig. 23. The spray in this case is formed by a straight stream striking a lip. The fineness of the spray is governed by the width of the aperture. If the hole is entirely open, a straight stream will be thrown and a mist will be formed, varying in fineness with the degree to which the hole is closed. At best, this nozzle can give only a rather coarse mist, and it, therefore, was being

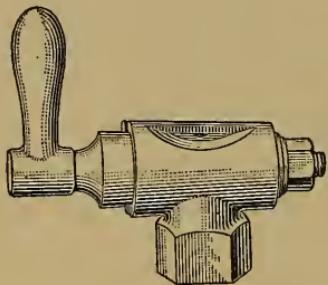


FIG. 23

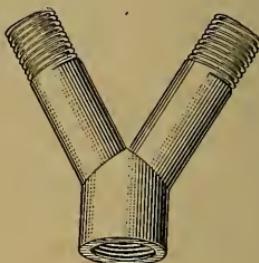


FIG. 24

discarded until the fact was discovered that it is important to have a coarse spray for the first spraying for the codling moth of the apple, and the Bordeaux nozzle seems to fill the purpose best. In using this nozzle with power sprayers, it is well to have two connected with a Y similar to that shown in Fig. 24, so that a large quantity of spray can be thrown at one time.

Another of the three important nozzles is the **Vermorel**, which is shown in Fig. 25, (a) being a perspective view and (b) a sectional view. The liquid enters the nozzle through the tube *a* into an eddy chamber where a whirling motion is given to the stream by the spiral deflector *b*, and passes out through the opening *c* in the center of the cap. This nozzle is rather troublesome about clogging, but it is provided with a needle *d* for

pushing out the obstruction. The needle is held back when not in use by a spring. A disadvantage of the needle is that

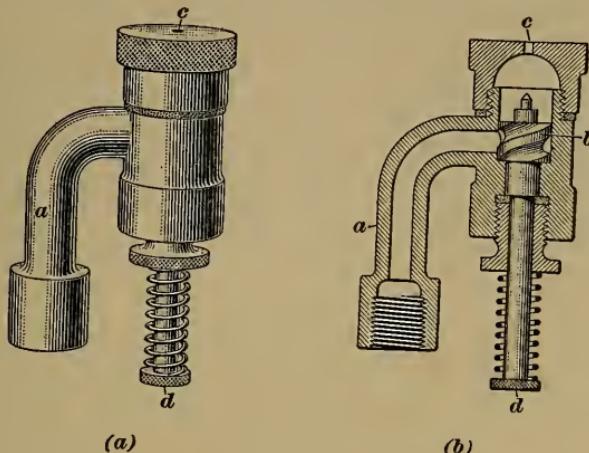


FIG. 25

the spring catches on limbs and twigs and gives some trouble.

The third of the important nozzles is what may be called a **disk nozzle**. It has no needle for removing obstructions, as the opening in the cap is large enough that there will be no obstruction if the spray is properly made. A nozzle of this type is illustrated in Fig. 26 (a). The spray liquid is forced to pass through two holes in a brass plate shown separately in view (b); these holes slant in opposite directions and give the liquid a whirling motion. A sectional view of the nozzle is shown in (c).

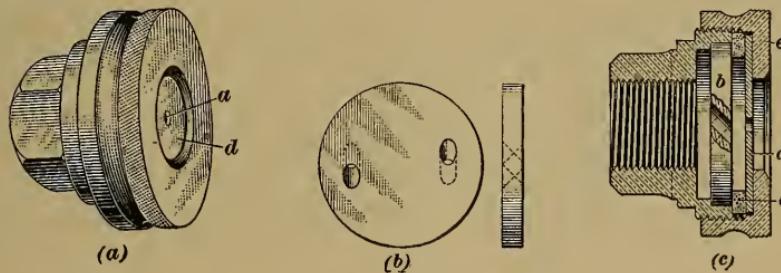


FIG. 26

In this view *b* is the brass plate shown in (b); above this is a leather washer *c* which separates the plate *b* from a thin metal

disk *d* and forms a chamber. The liquid enters this chamber with a whirling motion and is forced out through the small opening *a* shown in view (*a*). The parts are held in place by a

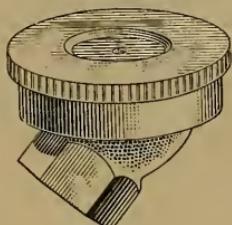


FIG. 27

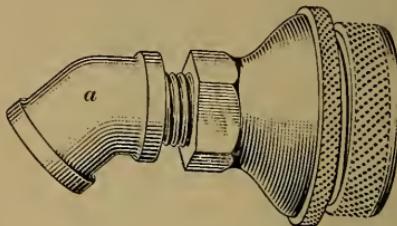


FIG. 28

brass cap *e*. Practically all power sprayers are provided with a nozzle of this class. Usually one of these nozzles to each line of hose will be sufficient, but two may be used to advantage by a person who has had considerable experience in spraying. When two are used they are connected with either a **U** or a **Y**, so as to have the least possible projection for catching on limbs.

Nozzles should practically always be attached to the rod so that a line projected from the hole in the center makes an angle of about 45 degrees with the rod. This can be secured by such a nozzle as is shown in Fig. 27 or by a bent tube called an elbow at the end of the rod, as shown at *a*, Fig. 28.

49. Extension Rod.—The rod for spraying should generally be from 8 to 10 feet long. Rods are made much longer than this, but the very long ones are difficult to manage, especially when the liquid is sprayed out under high pressure. These rods may be made of ordinary $\frac{1}{4}$ -inch gas pipe as illustrated in

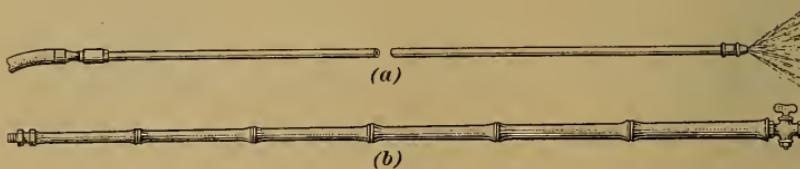


FIG. 29

Fig. 29 (*a*), or they may be made of brass strengthened by bamboo, as illustrated in (*b*). The brass-bamboo rods are more commonly used than the others on account of being

lighter, and as they are larger in diameter they fit the hand better. A rod of this kind should always have a ferrule projecting over the bamboo at the lower end to unite the frail

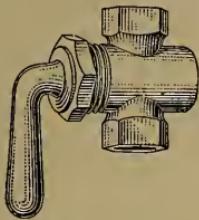


FIG. 30



FIG. 31

brass rod with the stronger bamboo and thus put the weight of the rod on the bamboo instead of on the brass. Rods made without this ferrule will not generally last very long.

50. Cut-Off.—At the lower end of the spray rod should be placed a cut-off that can be operated by a quarter turn. A cut-off of this kind is much more economical in saving the spray mixture than one that must be turned completely around to open or close. A good type of cut-off is shown in Fig. 30.

51. Hose.—The hose to which the extension rod is attached and through which the spray is pumped, should be first-class five-ply hose or stronger, and there is no advantage in having it large and heavy, since the small amount of friction developed by the passing of the liquid through a small hose will hardly be noticed in the working of the outfit.

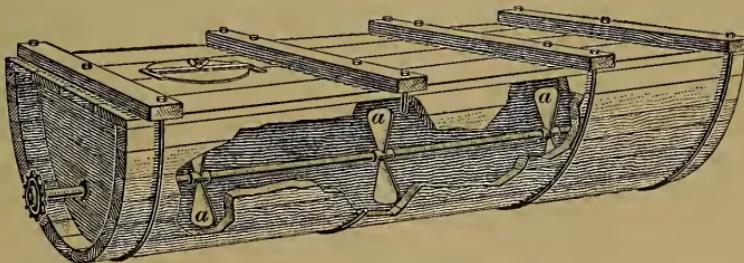


FIG. 32

52. Hose Clamp.—Fig. 31 shows a hose clamp, a supply of which, together with some pliable wire, should be kept on hand for mending hose.

53. Agitators.—All insoluble spraying mixtures should be thoroughly agitated. There are various types of agitators, for both barrel and tank sprayers. The most common types of barrel agitators are shown at *a*, Fig. 17 (*a*) and (*b*). The most satisfactory agitator for the power sprayer is the *propeller agitator*, shown at *a*, Fig. 32. This runs with a uniform strain on the engine and gives thorough agitation from the bottom, where agitation is most beneficial. The *swinging agitator*

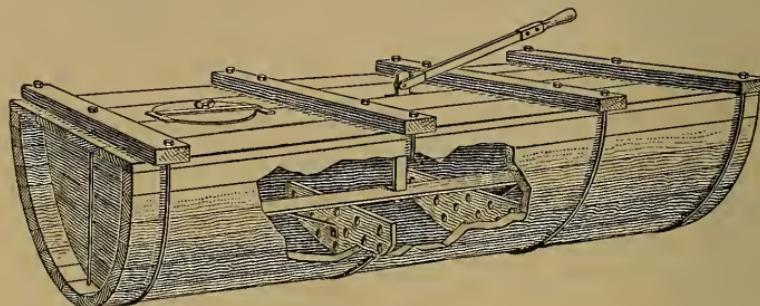
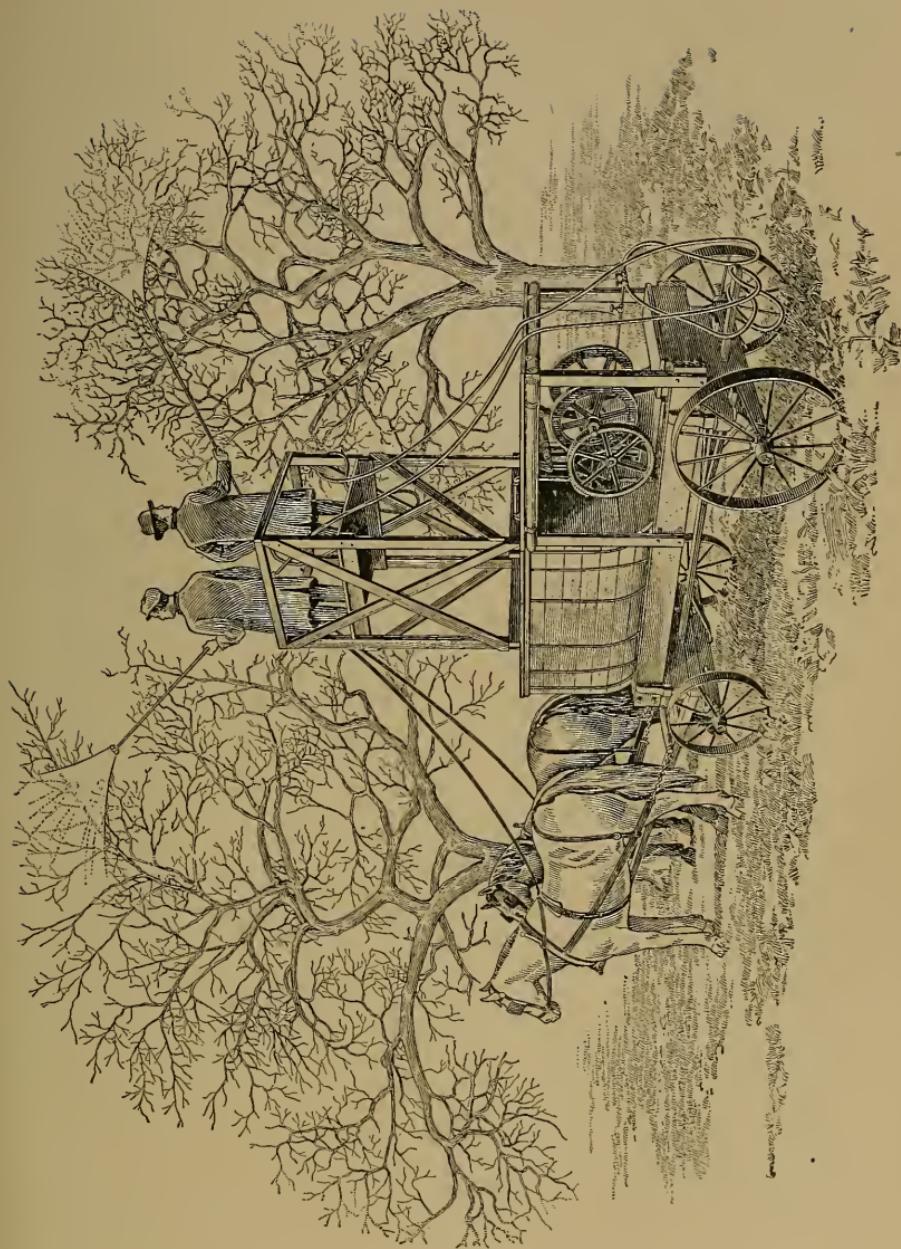


FIG. 33

shown in Fig. 33 is also used with success in many power sprayers and is the type used with hand-power tank sprayers.

54. Tower.—In spraying large trees, a tower from 5 to 7 feet high should always be attached to the top of the spray tank or to the wagon, so that the sprayer can stand on this and direct the spray downwards into the tree. Such a tower is shown in Fig. 34.

FIG. 34



VARIETIES OF APPLES

TERMS USED IN DESCRIBING VARIETIES

1. Terms Applying to Tree.—In describing any variety of apple it is necessary to tell something about the kind of tree on which the fruit is produced. The trees of different varieties vary considerably in size, vigor, form, type of twig produced, and habit of bearing, but those of any particular variety are very uniform in these respects.

In size, the trees of a variety may be habitually large, like those of the Northern Spy, or small, like those of the Oldenburg. They may be characteristically vigorous or they may tend to be weak. In form, the trees of a variety may be habitually spreading or habitually upright; the trees of a number of varieties tend to be upright, however, until loads of fruit cause them to be spreading; on the other hand, the trees of some varieties have the upright habit so strongly fixed that even after many years of bearing they still remain upright. In the case of some varieties the twigs are exceedingly slender, and in the case of other varieties they are strong and stocky; between these conditions there are many gradations. The trees of some varieties are uniformly heavy bearers; those of other varieties tend to bear heavily on alternate years; and those of still other varieties are light bearers. The location has considerable influence on the bearing habit of a variety, and in the descriptions that follow the trees of each variety will be discussed with reference to the section to which that variety is best adapted.

2. Terms Applying to Fruit.—Among the terms used in describing the fruit of a variety are: size; form; color of

skin; color, texture, flavor, and quality of the flesh; form of the cavity; and form of the basin.

Size in fruit is expressed in terms of very large, large, above medium, medium, below medium, small, and very small. These terms are, of course, relative; consequently, they are

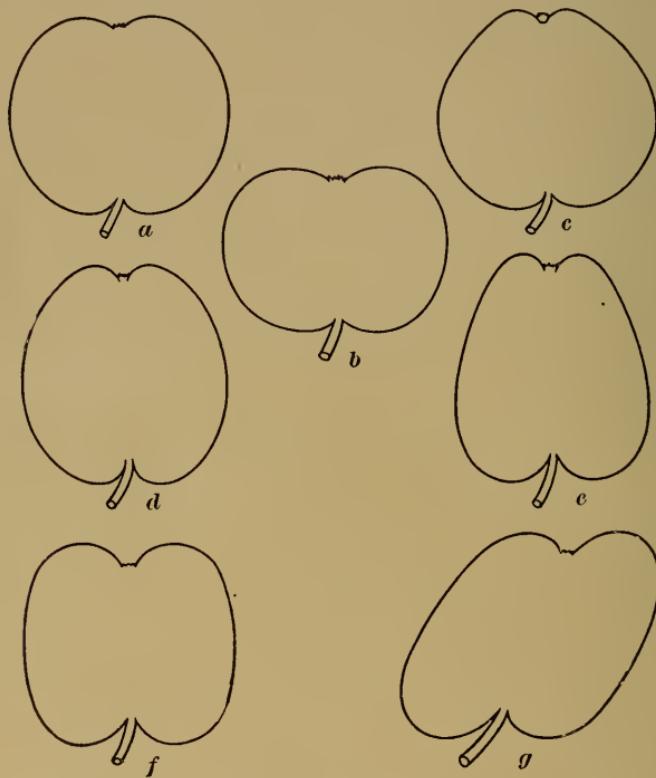


FIG. 1

incapable of being defined. The Wolf River is an example of a very large apple. The Baldwin and the Jonathan are examples of medium-sized apples.

In describing the form of an apple, the terms round, oblate, conical, ovate, oblong, truncate, and oblique are used in reference to the appearance when the apple is held with the vertical axis perpendicular to the line of sight. A round apple is one that appears roundish, as shown at *a*, Fig. 1. An oblate

apple is one that is slightly flattened, as shown at *b*. A conical apple is one that narrows considerably toward the blossom end, as shown at *c*; if the apple is round, as shown in the illustration, it may be designated as round conic to distinguish it from other forms of conical apples. An ovate apple is one that is egg-shaped—that is, one contracted toward both the stem and the blossom ends, as shown at *d*. An oblong apple is one in which the length from the stem end to the blossom end is greater than the transverse diameter. At *e* is shown an oblong apple that is conic toward the blossom end; this form is known as oblong conic. A truncate apple is one that is abruptly flattened at the end, as shown at *f*. An oblique apple is one in which the vertical axis slants obliquely, as shown at *g*.

The terms regular and irregular are used to describe the form when the apple is viewed at right angles to the transverse diameter. If the form is nearly circular the apple is said to be regular; if it is elliptical or angular, the apple is said to be irregular.

The color of the apples of a particular variety will vary with the conditions under which the fruit was grown. However, the fruit of a given variety usually has certain characteristics of color that distinguish the variety from others. In describing the color of an apple, distinction is usually made between what is known as the under color and the over color. The under color of an apple is the ground, or basic, color; it is often a yellow or pale green. The over color is the color that, in some varieties, is spread over the under color in the form of blushes, stripes, or splashes; it is usually some shade of red. The term blush is used to indicate that the surface is overspread with a reddish tint that is not much broken. The color of apples is also affected by dots found on the skin. These dots may be prominent or submerged, that is, they may stand out, conspicuously or they may be barely perceptible; in color they may be white, gray, or russet. If the dots are star shaped they are said to be stellate; if they shade from one color in the center to another on the outside they are known as areolar.

The color of the flesh is another distinguishing variety character. The flesh may be white, as in the McIntosh and the

Fameuse; it may be tinged with yellow, as in the Jonathan and the Baldwin; or it may be greenish white, as in the Rambo. In a few varieties the flesh is streaked with red, as in the Wealthy.

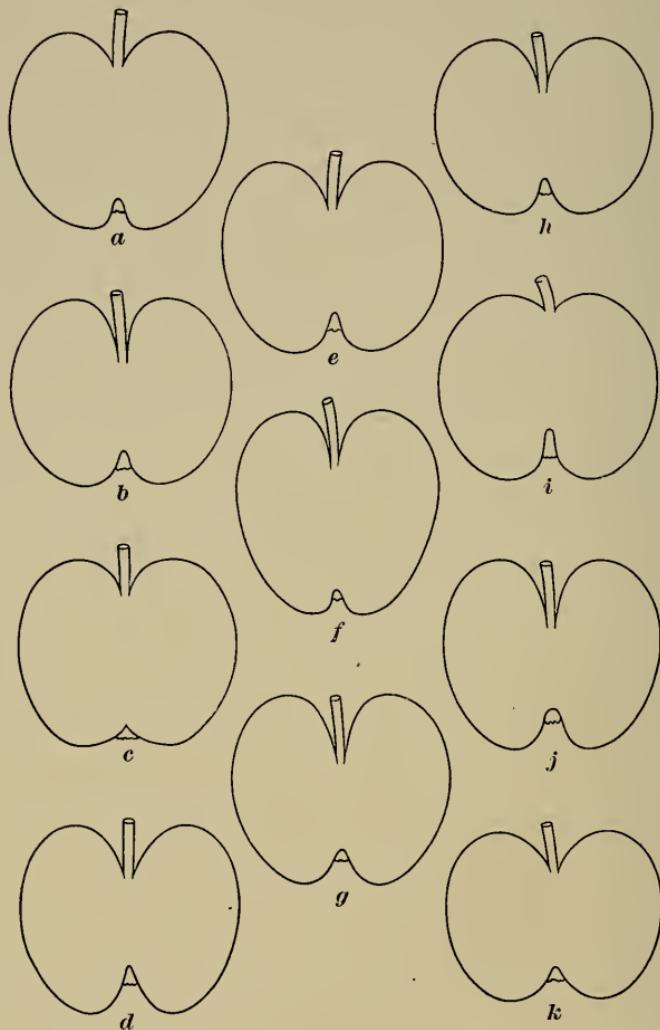


FIG. 2

The texture of the flesh of apples varies considerably, being fine grained or coarse grained, and firm or soft. In addition, the flesh may be juicy, as in the Jonathan, or it may lack in juiciness, as in the Ben Davis.

In flavor, the flesh of apples may be acid, as in the case of the Red Astrachan; subacid, as in the case of the Jonathan; or sweet, which means that the acid is almost entirely wanting.

In describing the quality of the flesh, the terms poor, fair, good, very good, excellent, and best are employed. As used by horticulturists, however, these terms designate qualities higher than would generally be understood by the layman. For example, an apple described as good is one of only medium quality.

The cavity, that is, the depression around the stem, differs somewhat in different varieties of apples. If the angle formed is wide, as shown at *a*, Fig. 2, the cavity is said to be obtuse; if the angle is sharp, as shown at *b*, the cavity is said to be acuminate; if the angle is intermediate, as shown at *c*, the cavity is said to be acute. The terms wide, medium, and narrow, referring to the spread, or width, of the cavity, and deep, medium, and shallow, referring to the depth, also are used. At *d* is shown a wide cavity; at *e*, a medium wide cavity; at *f*, a narrow cavity; at *g*, a deep cavity; at *h*, a medium deep cavity; and at *i* a shallow cavity.

The form of the basin, or the depression at the blossom end of an apple, is also a variety character. The basin may be shallow, medium deep, or deep; it may be narrow, medium wide, or wide. The basin whose sides show a sudden slope, as illustrated at *j*, Fig. 2, is termed abrupt; if the sides slope gradually, as shown at *k*, the basin is said to be obtuse.

DESCRIPTION OF VARIETIES

3. A great many varieties of apples are offered to the fruit growers of the country by nurserymen. To describe all of these would be neither possible nor advisable for the present purpose. The varieties described in the following pages are important ones that every orchardist should know. The specimens from which the illustrations were made were collected from different regions and although each is fairly characteristic of the variety to which it belongs, it should be remembered that the same variety when grown in different sections may assume somewhat different characters. In other words, varieties of apples are susceptible to change of environment.

SUMMER VARIETIES

4. Yellow Transparent.—The Yellow Transparent is a variety of Russian origin that was introduced into this country in 1870. It is now grown commercially in many sections and is a good variety for home orchards. The tree is rather a slow grower and in some parts of the West suffers considerably from twig blight, a disease described in another Section. The tree bears at an early age; often 2- or 3-year-old trees will set considerable fruit. The fruit, when mature, is above medium in size and of a beautiful, clear, yellowish-white color. The flesh is white, juicy, and of a pleasant flavor. The skin is somewhat tender and for this reason the fruit must be picked almost every day during the ripening season in order to reach the market in good condition. In New York the apples begin to ripen in July and continue to be in season until the last of August or early in September.

5. Red June.—The Red June variety has been in cultivation for a long time and is widely distributed. The tree is

fairly vigorous, upright, and rather dense. It is productive, but does not come into bearing at an early age. The fruit is small to medium in size; when it is well colored almost the entire surface is a deep red. The flesh is tender and juicy, and the quality is good to very good. This apple, like the Yellow Transparent, is somewhat tender in skin and must be handled carefully. In Virginia it ripens in late June or early July; in New York the season is from late July to early winter.

6. Early Harvest.—The Early Harvest is one of the oldest and most widely disseminated varieties of summer apples in America. The tree is vigorous and healthy, and comes into bearing rather young. The fruit is medium in size, pale yellow in color, pleasant in flavor, and of very good quality. The fruit has the fault of being irregular in size and shape and there are many poor, knotty specimens, so that in general the variety is hardly to be recommended for commercial planting, although it is desirable for a home orchard. In Virginia the Early Harvest apple ripens about the last of June; in New York the season is from late July to August.

7. Red Astrachan.—The Red Astrachan is a widely known summer variety. The tree is of medium size and fairly vigorous, although in some sections it is not very productive. The fruit is medium to large in size; the under color is greenish or greenish yellow, and the over color, which nearly covers the apple, is deep crimson, either shaded or in splashes. The fruit is a little too sour for dessert purposes, but is excellent for cooking. The apples mature unevenly and several pickings are necessary. In addition, they are very perishable and consequently not well suited for long-distance shipment; the fruit is generally sold locally. In Virginia the Red Astrachan ripens early in July; in New York the season is from late July to September.

8. Oldenburg.—The Oldenburg, or *Duchess of Oldenburg*, is a Russian variety that is adapted to a cool climate. It is widely disseminated and is considered to be one of the most

important of summer apples. The tree is a rather slow grower and medium in size, but comes into bearing young, and bears well in most localities. The fruit is medium to large in size and roundish to oblate in form. The under color, which is yellowish, is almost completely covered with irregular splashes and stripes of red shaded with crimson. The fruit is rather too acid for dessert use, but is especially good for cooking purposes. The Oldenburg is a valuable commercial apple, as it stands shipment fairly well and is generally in demand on the market. In Virginia the fruit ripens about the last of July; in New York the season is from late August to September.

9. Benoni.—The Benoni is an old Massachusetts variety of apple. The tree is a medium grower but comes into bearing rather young and bears fairly well. When the tree begins to get old it has a tendency to bear crops in alternate years rather than each year. This fault can be corrected, however, by good cultivation and heavy pruning. The fruit is excellent in quality but as commonly grown is rather too small to be of general market value. With heavy pruning and good care, however, the Benoni is a valuable market apple. The color is yellowish, oversplashed with red and striped with crimson. Although the ripening season of the fruit is rather long, the entire crop can, as a rule, be harvested in two pickings. The young fruit is resistant to severe cold and for this reason the variety bears in some sections where most others are killed by frost. The Benoni seems especially well adapted to the Ozark section of Missouri. In New York the fruit begins to ripen about the first of August and the season extends into September.

10. Maiden Blush.—The Maiden Blush is one of the best known summer apples. The tree is vigorous and hardy and comes into bearing rather early. The fruit is above medium in size; the color is a pale yellow with a crimson blush on one side; and the quality is fairly good. The apple is suitable for both dessert and cooking purposes and is a standard market variety. The Maiden Blush is desirable for either commercial or home orchards. In Virginia the fruit ripens late in

July or early in August; in New York the season is from July to September.

11. Gravenstein.—The Gravenstein is a summer variety that is fairly well known in most sections. The tree is a strong, vigorous, spreading grower, and under proper culture it produces crops nearly every year. However, under ordinary culture it has a tendency to produce only in alternate years. The fruit is medium to large; the form is roundish oblate; and the color is yellowish, striped and splashed with red; the flesh is yellowish and firm and the quality is very good. In Virginia the Gravenstein ripens in early August; in New Jersey the fruit may be allowed to remain on the trees until September; in New York the season is from late September to early November.

FALL AND WINTER VARIETIES

12. Fall Pippin.—The Fall Pippin is a desirable fall apple that is grown commercially in some parts of the East. The trees attain a large size, are moderately vigorous, are strong growers, and live for many years. The fruit is large, and when ripe is of an attractive yellow color. The flesh is tender and good in quality, being prized for both dessert and culinary purposes. The crop ripens unevenly, the first apples often being ready in September and the last not until a few weeks later. The fruit and foliage are very susceptible to apple scab, and for this reason good orchard treatment is necessary when the variety is grown. Coming as they do in the fall before winter apples, and being of good quality, the apples are generally in demand on the market. The variety is very desirable for home orchards as well as for commercial orchards. The fruit ripens very unevenly; it can be kept in ordinary storage until December, and in cold storage until January or February.

13. Sops of Wine.—The Sops of Wine variety is grown to some extent in home orchards. The tree is medium in size and rather vigorous. The fruit is medium to large in size

and of roundish form. The skin, which is slightly roughened, is a greenish yellow in color, almost entirely overspread with purplish red, mottled, irregularly splashed, and sometimes indistinctly striped with dark carmine; the skin is overspread with thin white bloom. The flesh is yellowish, often stained with pink; in flavor it is aromatic, juicy, and of good quality. The season of the Sops of Wine apple is from August to October.

14. Alexander.—The Alexander is a fall, or in some sections a late summer, variety that is grown commercially in many apple-growing regions. The tree is a strong grower and comes into bearing at an early age. The fruit is round conic or oblate conic, very large in size, but coarse in texture and only fair in quality; it is better suited for cooking than for dessert purposes. However, the apples are very attractive in appearance, being greenish yellow or pale orange and overlaid with stripes and splashes of bright red. The fruit usually brings a good price on the market. In Virginia the season begins early in July; in New York it continues until September or November.

15. Wolf River.—The Wolf River apple is similar in many respects to the Alexander; in fact, it is supposed by some authorities to be a seedling of the latter. The tree is fairly vigorous, attains large size, is spreading in habit, and comes into bearing rather late. The fruit is large, broad, flat at the base, round, and slightly conic. In color, the fruit is yellowish or greenish, mottled and blushed with deep red, and splashed and striped with bright carmine; the surface is covered with numerous large to medium-sized areolar pale or russet dots. The basin is usually deep, narrow, abrupt, and rather smooth. The cavity is acuminate, fairly deep and wide, and heavily russeted. Fig. 3 shows a Wolf River apple that was grown in Northwestern Pennsylvania. The flesh is yellowish, somewhat coarse, juicy, but only fair to good in quality. Largely on account of the high color and large size, the apples are in demand on the market. As a commercial variety of late summer apple, especially in the Western fruit-growing regions,



the Wolf River is more widely grown than the Alexander. Recently, numerous commercial orchards of the variety have been planted in the East. In New York and Pennsylvania the Wolf River ripens in September, but the apples may be kept until December in cellar storage or until January in cold storage.

16. Wealthy.—The Wealthy is an important fall apple that is extensively grown in the Central States and to some extent in the Eastern States. The tree is hardy and a thrifty grower when young, but with maturity it becomes a rather slow grower. The fruit is from medium to large in size, roundish oblate, fairly uniform in shape, and of very good quality. The under color is yellow or greenish, heavily overlaid with stripes of red and marked with numerous small inconspicuous pale or russet dots. The flesh is white, sometimes tinged with red. The quality is very good and the fruit is desirable both for dessert and for cooking. In New York the fruit begins to ripen about the last of September or the first of October; it can be kept in ordinary storage until about November 1, and in cold storage until the middle of January or later. As a commercial variety the Wealthy has proved profitable in many sections.

17. Twenty Ounce.—The Twenty Ounce variety, known also as the *Cayuga Redstreak*, the *Wine Apple*, and the *Limbertwig*, seems to do particularly well in favorable locations in the apple-growing belt south of Lake Ontario. It is highly esteemed for home-orchard planting. The tree is upright, moderately vigorous, and dense. The fruit is very large, and is usually roundish or roundish conic in form, sometimes broadly ribbed. The skin is thick and tough; in color it is greenish at first, but gradually becomes rather yellow, washed, mottled, and splashed with bright red, and striped with carmine. The flesh is whitish, somewhat tinged with yellow, coarse, moderately tender and juicy. The fruit is good for culinary use but only second rate for dessert. The season is from late September to early winter.

18. Fameuse.—The Fameuse, an old variety, is decidedly a northern apple, being one of the most important commercial varieties in the Champlain district in New York and in Southern Canada; it is extensively grown also in Wisconsin and Minnesota. The tree is of medium size and is a moderate grower, fairly healthy, and long lived; however, trees of this variety are, unless well sprayed, likely to be seriously injured by apple scab. The fruit is beautiful in appearance and excellent in flavor; it is very desirable for dessert purposes and usually sells at prices above the average for apples, being in strong demand for the Christmas trade. The fruit is about medium in size; in form it is roundish and somewhat conic. The skin is of a light bright-red color that deepens to purplish black in the best colored specimens, with a striped appearance toward the apex. The flesh is white and often streaked or tinged with red. The quality is very good. In New York the season of the Fameuse is from October to midwinter.

19. McIntosh.—The McIntosh apple is similar to the Fameuse but is adapted to a wider range of climatic conditions. The tree varies in growth and productivity according to the region where it is grown; in some localities it is considered to be a slow grower and not very productive; in other localities it is considered to be a strong grower and to be hardy and productive. It comes into bearing fairly early and, as a rule, yields good crops. The fruit is medium to large in size; roundish to oblate in form; and whitish yellow or greenish in color, deeply blushed with bright red and striped with carmine; ripe, highly colored specimens become a dark, purplish red. The flesh is white or slightly yellowish and, like that of the Fameuse is often tinged with red. The quality is very good and the fruit is highly prized for dessert purposes. In New York the McIntosh ripens during the last of September and can be kept until about the last of October in ordinary storage, or until about January in cold storage. The McIntosh lacks sufficient firmness to stand much handling, and consequently is more often sold locally than otherwise. However, in the Bitter Root Valley of Montana, and other high sections of the West, the

variety is grown rather extensively and the fruit is shipped long distances to market.

20. Hubbardston.—The Hubbardston is a desirable apple that ripens between the fall and late winter apples. It is grown commercially in parts of New York and Northern Pennsylvania, and in most cases has proved to be a profitable variety. The tree is vigorous and generally of good size, but tends to overbear; unless it is carefully pruned and otherwise cared for, however, it is likely to be only moderately vigorous and of medium size. The tree is susceptible to apple canker, and for this reason it is well to top work the variety on some such variety as the Northern Spy. The fruit is medium to large in size and generally roundish ovate in form. The skin is either smooth or roughened with dots, flecks, or veins of russet. The color is yellowish or greenish, blushed and mottled with red that varies from a dull brownish red to a bright, clear red. Large, regular dots are conspicuous on the surface, especially on the red portions of the fruit. The prevailing effect of a well-colored specimen is red mingled with yellow or green. In Fig. 4 a well-colored Hubbardston apple is shown at the top of the page; this apple was grown in Northern Pennsylvania. The flesh of the Hubbardston is whitish, slightly tinged with yellow, and the quality is very good to best. The season is from October to January.

21. Pumpkin Sweet.—The Pumpkin Sweet, often known as the *Pound Sweet*, is an early-winter variety that is well known in New England, New York, and Northern Pennsylvania. By many it is esteemed as one of the best sweet apples for baking, but generally it is not valued for dessert because it is rather coarse and has a peculiar flavor. The fruit is sold in local and special markets and has a limited demand in the general market. The tree is medium in size, is rather vigorous, and tends to be upright in habit. The fruit is large to very large; the form is globular to roundish conic; and the skin is rather thin, tough, and smooth. In color the skin is green, eventually becoming clear yellow, marbled with greenish yellow stripes of white scarf skin radiating from the cavity. In Fig. 4 the apple



FIG. 4

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FIG. 5

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at the bottom of the page is a Pumpkin Sweet that was grown in Western New York. The flesh of the Pumpkin Sweet is tinged with yellow, and is firm and medium in texture; the quality is good. The season of this variety extends from October to January. The Pumpkin Sweet is grown commercially only to a limited extent, but is often found in home orchards.

22. Northern Spy.—The Northern Spy, more commonly known perhaps as the *Spy*, is a widely known winter variety of apple that is grown commercially and in home orchards in about the same localities that produce Baldwins and Rhode Island Greenings. The tree is large, vigorous, and upright, but is a slow grower and comes into bearing rather late. When mature, however, the trees are good yielders. The fruit is usually large to very large in size and generally roundish conic in form. The under color, in the case of well-matured specimens, is a clear pale yellow, which is nearly concealed by a pinkish red splashed with carmine. The prevailing color effect is red or reddish striped. In underripe apples the yellow color may predominate, but such fruit is often of inferior quality. In Fig. 5 a Spy is shown at the top of the page; this apple was grown in Pennsylvania.

Among the disadvantages of the Spy for commercial planting are its slow maturity and the fact that in some seasons it is not a reliable cropper. To offset these disadvantages, however, are the facts that the Spy is well and favorably known on the market and can generally be depended on to bring a good price. The season is somewhat shorter than that of the Baldwin or Greening, as the fruit, particularly if bruised, is susceptible to rotting in storage. Usually in ordinary storage the apples cannot be kept much later than February or March, and in cold storage they are likely to deteriorate if left longer than March.

23. Tompkins King.—The Tompkins King, or *King*, one of the highest quality apples produced, is grown in about the same region as the Baldwin, the Northern Spy, and the Greening. The tree is rather vigorous but is seriously subject to injury from sun scald, canker, and an injury that occurs to the trunk near the surface of the ground, which is generally spoken of as

collar rot. The lateral branches are rather slender and somewhat drooping. The fruit is large to very large and in form is roundish to somewhat oblate, sometimes inclined to conic. The skin is smooth or in some cases is roughened with russet dots. The color is yellow, mottled and washed with orange red that often shades to deep red and striped and splashed with bright carmine. Numerous white or russet dots are conspicuous on the surface. The prevailing color is an attractive red with a small amount of yellow. In Fig. 5 the lower apple is a Pennsylvania-grown King of excellent color. The flesh of the King is a rich yellow in color, tender, aromatic, and juicy; in quality it is very good to best. The King does not keep well in late storage; in ordinary storage its limit is December or January; in cold storage, about February. It is probably at its best about Christmas.

The King is much in demand on most markets, and sells for good prices. It is very attractive in appearance, and being of excellent quality, is well adapted for fancy trade. However, the fact that the trees are so subject to disease makes the planting of the variety commercially a questionable practice. Some orchardists have found that by top working the King on some variety that is less susceptible to collar rot better results can be obtained than by growing the trees on their own stocks.

24. Yellow Bellflower.—The Yellow Bellflower is one of the oldest of American varieties. The tree is large in size, vigorous, a good grower, and fairly hardy, but often does not produce satisfactory crops. The fruit is variable in size and roundish oblong in form. The skin is thin and smooth. In color, the fruit is a pale lemon yellow, often becoming brownish yellow where exposed to the sun. The apples are very attractive and are excellent both for dessert and for cooking purposes. The flesh is white, tending slightly toward yellowish; the quality is good. By some the flesh is thought to be somewhat too acid early in the season. The season for this variety is about the same as that of Tompkins King, the cold-storage limit being about January. The Yellow Bellflower is grown

extensively in home orchards, but on account of the tendency of the trees to bear poorly it is not grown on a very large scale in commercial orchards.

25. Ortley.—The Ortley is a pale-yellow apple of the Yellow Bellflower type that has long been under cultivation. The tree is moderately vigorous, medium in size, and roundish or spreading in form. The fruit is large or medium in size and oblong conic varying to roundish conic in shape. The skin is moderately thin, smooth, waxy, and of a pale whitish-yellow color, varying to rich yellow in well-developed fruit. The flesh is whitish tinged with yellow, crisp, juicy, and of good flavor. The season of the fruit is from October to February. The Ortley is severely subject to attacks of various insects and of the scab fungus, and requires thorough treatment to protect it from these troubles.

26. Jacobs Sweet.—The Jacobs Sweet variety has about the same season and is grown in about the same localities as the Tompkins King. As a home-orchard variety it has considerable merit, but for commercial planting it is not particularly desirable. The tree is vigorous, attains good size, comes into bearing young, and, as a rule, yields crops annually. The fruit is large to very large and is of roundish form inclined to conic, sometimes slightly oblate. The skin is tough, slightly waxy, and glossy, and in color is clear yellow or greenish, often with a blush of red. Fig. 6 shows a Jacobs Sweet apple that was grown in Northern Pennsylvania. The flesh is whitish, tinged with yellow, juicy, and very sweet. The quality is good, the apples being especially desirable for baking. In New York the season is from October to March or April.

27. Blue Pearmain.—The Blue Pearmain is an old variety that was at one time extensively planted in home orchards in the East. It is rarely grown in commerical orchards. The tree is rather large, spreading, and moderately vigorous. The fruit is above medium to large in size; it is roundish inclined to oblate in form. The skin, which is rough, is yellow, washed and mottled with red, often deepening on one side to nearly solid red, splashed and striped with deep purplish carmine,



FIG. 6



FIG. 7

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and overspread with an abundant blue bloom, from which the variety derives its name. The flesh is yellowish, rather coarse, decidedly aromatic, and of good quality. The season of the Blue Pearmain is from about October to March; often, however, the apples begin to shrivel if kept longer than January.

28. Banana.—The Banana, or *Winter Banana*, variety is grown commercially in some sections of the Northwest. It does fairly well also in parts of the eastern and central apple-growing regions. The tree is medium in size, vigorous, and a fair grower; it comes into bearing early and yields moderate crops, being, in most cases, an annual bearer. The fruit is medium to large in size, and roundish conic to oblong conic in form, often oblate and flat at the base. The skin is smooth, fairly thick, tough, and waxy. In color, the apples are a bright pale yellow with a dark pinkish blush. In Fig. 7 a Banana apple is shown at the top of the page; this apple was grown in Pennsylvania. The apples, being yellow, show bruises readily. The flesh is whitish, tinged with yellow, moderately firm, tender, and juicy; the quality is good to very good. The apples are better for dessert than for cooking, being too mild in flavor for the latter purpose. They command a good price on the market, being of an attractive appearance and of good dessert quality. They will keep in cold storage until about March, but as they show bruises readily it is generally desirable to market them earlier in the season.

29. Baldwin.—The Baldwin is by far the most important commercial winter apple grown in America. It is grown extensively in New York, Pennsylvania, New England, parts of Northern Ohio, Southern Canada, Michigan, and in some of the high mountain sections of Virginia and West Virginia. The Baldwin is a standard fruit in both American and foreign markets, and is one of the principal varieties handled in cold storage.

In sections where the Baldwin is especially adapted, the tree is a strong grower, long lived, and vigorous. However, the tree is somewhat slow in coming into bearing, but when it reaches maturity it bears very abundantly. As generally

grown, the tree bears biennially rather than annually. The fruit, if grown properly, is usually above medium in size, and is rather uniform; in form it is roundish, inclined to conic, or sometimes roundish oblong. The cavity is acute and medium to rather deep; the calyx is small to rather large; the basin is abrupt, and varies in different specimens from narrow to moderate in width. The skin is tough and smooth; the color is a light yellow or green, blushed and mottled with bright red and striped rather indistinctly with carmine. The prevailing color effect is red, as may be seen in Fig. 7, which shows a Pennsylvania-grown Baldwin apple at the bottom of the page. Whitish or grayish dots are conspicuous, as a rule, being somewhat numerous and smaller toward the basin than toward the cavity. The flesh is yellowish in color, moderately coarse in texture, and the quality is good to very good; the fruit is suitable for both dessert and cooking purposes. In New York the season extends from November to March in ordinary storage, or to May or June in cold storage.

Among the advantages of the Baldwin as a commerical apple are its good quality, its red color, its good shipping qualities, its good keeping qualities in cold storage, and the fact that it is well known by consumers. These qualities make it in demand on the market. A disadvantage of the variety is that it is likely to be troubled with Baldwin spot, a disease that manifests itself in small brown flecks in the flesh of the fruit. This disease is a physiological one and no remedy is known. Other disadvantages of the Baldwin are that it tends to be a biennial bearer and that unless it has proper culture the apples are likely to be small in size.

30. Smokehouse.—The Smokehouse is an early-winter variety that is grown rather extensively in Southern Pennsylvania, Maryland, Delaware, and New Jersey. The tree is vigorous, healthy, and hardy; it comes into bearing rather young, and is a good yielder, usually producing crops annually. The trees are likely to form dense heads, and for this reason should be kept well pruned to insure highly colored fruit. The fruit is from medium to large in size and generally roundish oblate





FIG. 9

in form; sometimes, however, it approaches oblate conic. The skin is thin and tough, and is either smooth or slightly roughened with russet lines and russet dots. The color is yellow or greenish, mottled with rather dull red, sometimes deepening to solid bright red, indistinctly mottled, striped, and splashed with carmine. Fig. 8 shows a Smokehouse apple that was grown in Maryland. The flesh is lightly tinged with yellow, and is rather firm, crisp, and juicy; the quality is good. The Smokehouse is especially prized for dessert. Its season is from October to February in storage.

31. Black Gilliflower.—The Black Gilliflower apple is well known in the markets of America. The tree is medium in size, a vigorous grower, and generally a reliable cropper. The fruit is medium in size, and very characteristic in form, being long ovate to oblong conic. The skin is thick, tough, and smooth. The color is yellowish or greenish, generally covered with red, which, in highly colored specimens, becomes a dull purple. Fig. 9 shows a Black Gilliflower apple. The flesh is whitish or yellowish and becomes mellow on standing. The Black Gilliflower seems to be in considerable demand in southern markets. It is grown commercially to some extent, largely on account of being a well-known variety that will bring fair prices on the market. The season is from October to January or February.

32. Missouri.—The Missouri, or *Missouri Pippin*, is a well-known market apple of the Middle West, especially of Missouri, Kansas, and Illinois. The tree is moderately vigorous, irregular in outline, and rather short lived; in the Mississippi Valley the trees usually do not live to be more than 20 years old. The trees come into bearing young, however, and for this reason they are much used for fillers in commercial orchards. The fruit is medium to small in size, and roundish inclined to conic in form. The skin is thick, tough, smooth, glossy, and thinly coated with a grayish bloom. The color is a pale green overspread with bright red and striped with purplish red. Highly colored specimens are almost solid red, except for conspicuous russet or pale-gray dots. A Missouri apple is



FIG. 10





FIG. 12

illustrated in Fig. 10. The flesh is yellowish or greenish, firm, medium to rather fine grained, rather tough, and not very juicy. The quality is fair to good. The season in common storage extends to January, and in cold storage to about April.

33. Rambo.—The Rambo is a northern apple that has been under cultivation in America for a long time. Its origin is unknown. The tree is of medium size, moderately vigorous, and susceptible to winter killing. The wood is brittle and for this reason the branches are easily broken. The fruit is medium in size and roundish or somewhat oblate in form. The skin is thin and rather tough; in color it is a pale greenish yellow, mottled with red and striped with carmine. The prevailing color is a red with contrasting yellow. Fig. 11 shows a Rambo that was grown in Southern New York. The flesh is white, tinged with yellow or green; it is juicy, rather fine grained, and of good to very good quality, particularly for dessert. The variety is recommended for home-orchard planting, but it is not especially desirable for commercial orchards. Numerous small Rambo orchards are found in New York, Pennsylvania, Ohio, and some of the Central States. In ordinary storage the apples keep until November, and in cold storage until February.

34. Ribston.—The Ribston is an apple that is in season about with Hubbardston and Tompkins King. It is an old variety, having originated over 200 years ago in Yorkshire, England. It is grown commercially in Nova Scotia and Ontario, and much of the fruit is exported to England. The tree is medium in size, hardy, vigorous, healthy, comes into bearing young, and is usually an annual bearer. The fruit is medium in size and is roundish in form, often somewhat flattened at the base. The skin is either smooth or slightly roughened with russet; in color it is a deep yellow or greenish yellow, overspread with a dull red. Fig. 12 shows a Ribston apple that was grown in Nova Scotia. The flesh is tinged with yellow, is firm and juicy, and the quality is very good. The season extends from September to December or January or later.



FIG. 13



35. Tolman.—The Tolman, or *Tolman Sweet*, is a yellow, rather attractive sweet apple that is grown to a limited extent in New England, New York, Pennsylvania, Southern Canada, and in the prairie regions of the Central States. The tree is moderately vigorous, a good grower, long lived, and very hardy. The fruit is about average in size, and is nearly globular in form. The skin is tough and in many specimens is marked by a suture line that extends out from the cavity and sometimes reaches as far as the basin. The color is a pale yellow, sometimes slightly blushed. Fig. 13 shows a Tolman apple. The flesh is white, firm, and rather hard; in quality it is very good. The taste is decidedly sweet. The variety is not planted to any extent in commercial orchards; but often the fruit from small orchards can be disposed of locally to a special trade. In ordinary storage the apples will keep until about January 1 and in cold storage to about March or April.

36. York Imperial.—The York Imperial, known locally as the *Hillside* apple, is a widely known variety that is grown commercially in Southern Pennsylvania, Maryland, Virginia, West Virginia, and westward into Missouri and Kansas. When grown in regions farther north, the fruit is likely to be deficient in size, color, and quality. This variety originated as a chance seedling near York, Pennsylvania, and largely on account of its excellent keeping quality when kept in ordinary storage, it soon became distributed to the near-by regions and later was adopted for commercial planting in the Central States.

The tree is vigorous, a thrifty grower, a good cropper, and bears biennially, or, in some cases, annually. The fruit is medium to large when grown under favorable conditions. In form it is roundish oblate and distinctly oblique, or lopsided, as shown in Fig. 14, which illustrates a York Imperial apple from Southern Pennsylvania. The lopsided form is a distinct characteristic of the variety. The skin is tough, bright, and smooth. The color is a green or a yellow blushed with a pinkish red and sometimes striped indistinctly with carmine. The flesh is yellowish, firm, and fairly juicy; in quality it is generally good, but in some cases only fair. The



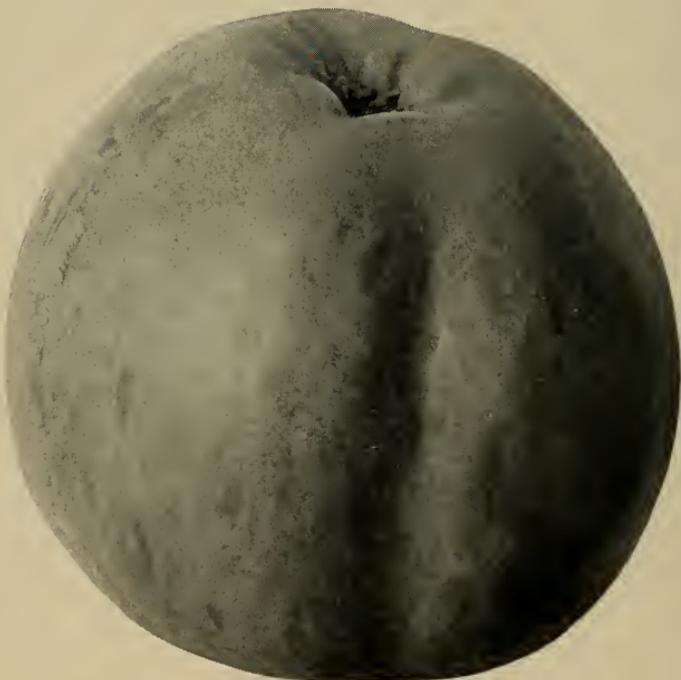


FIG. 16

fruit varies as to the length of time it will keep in storage. In cellar storage it will sometimes keep until April or later and at other times it may last only through January. In cold storage it seems to scald badly, and may last only through February.

37. Smith Cider.—The Smith Cider apple is well known in Southeastern Pennsylvania and Northeastern Maryland and is grown to some extent in Western Ohio and Eastern Indiana, principally in home orchards. The tree is moderately vigorous and has long, stout, straggling branches. The fruit when well grown is from medium to large in size, but under average conditions it is below medium. The form is round, sometimes oblate inclined to conic. Occasionally, the sides are unequal, as in the York Imperial. The skin is thin and tough and either smooth or slightly roughened with russet lines about the basin. The color is a pale yellow or green, mottled and shaded with pinkish red, and splashed and striped with a bright carmine. The prevailing color effect is a striped pinkish red. Fig. 15 shows a Smith Cider apple that was grown in Maryland. The flesh is whitish in color and firm in texture. The apple is juicy, of good flavor, and especially desirable for cooking purposes. It will keep in cellar storage until January or February and sometimes longer. In cold storage it can be kept until March.

38. Cranberry.—The Cranberry is a fall or early-winter variety that is well known in parts of New York and Southern Canada. The tree is large, vigorous, hardy, and, as a rule, productive. The fruit is large in size and roundish oblate in form. The skin is smooth and glossy; in color it is a clear yellow, overlaid, in the case of well-colored specimens, with blushes, splashes, and stripes of scarlet. Fig. 16 illustrates a Cranberry apple that was grown in Ontario. The flesh is white or sometimes slightly yellowish, firm, juicy, and of fair to good quality. The fruit is more desirable for cooking than for dessert. The season varies according to the locality where the fruit is grown. In Ontario and Northern New York the

apples will keep until midwinter; in Southern New York they will last only until about the first part of December.

39. Esopus.—The Esopus, or *Esopus Spitzenburg*, commonly known simply as the *Spitzenburg*, is an apple of the Baldwin type, but is of better quality and more highly prized as a fancy dessert fruit than the latter. It is also a good-quality cooking apple. The variety is grown commercially to a limited extent in New York and other of the Eastern States, but its importance as a commercial apple is greatest in the northwestern fruit-growing section of the United States.

The tree of the Spitzenburg is rather a slow grower and generally rated as a moderate cropper. The fruit ranges from medium to large in size; the form is rather broad and flat at the base, varying from oblong to roundish ovate or roundish conic. The skin is tough and often waxy, and is roughened by russet dots. The under color is yellow and is overlaid with bright red inconspicuously striped with a darker red. In well-colored specimens the red assumes a purplish tint and the surface is marked with pale yellow and russet dots. In Fig. 17 a fancy Washington-grown Spitzenburg apple is shown at the top of the page. The flesh of the Spitzenburg is yellowish in color, crisp, and tender in texture, and of very good to best quality. The season extends from November to February or March in ordinary storage and to May or June in cold storage.

The advantages of the Spitzenburg are high color, good quality, and uniformity of shape. When packed in attractive packages the apples bring a fancy price on the market. The disadvantages of the variety are that the tree is a slow grower and is subject to canker, and that the fruit is subject to apple scab. These troubles can largely be controlled, however, by careful spraying, pruning, cultivating, and fertilizing.

40. Arkansas Black.—The Arkansas Black, a seedling of the Winesap, is a beautiful apple, is a good keeper, and brings good prices on the market, but it has the disadvantage of being rather non-productive. The tree is only moderately vigorous. The fruit is medium in size, and nearly round in form. The skin is smooth and waxy, and in color is yellow



FIG. 17

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FIG. 18

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overlaid with a bright red that on the side exposed to the sun becomes a purplish red. In Fig. 17 an Arkansas Black apple is shown at the bottom of the page; this apple was grown in Washington. The flesh of the Arkansas Black is yellowish, firm, crisp, and fairly juicy; in quality it is good to very good. In cold storage the fruit will keep until April or May. On account of its non-productivity the variety is not recommended for extensive planting.

41. Westfield.—The Westfield, or *Westfield Seek-No-Further*, commonly known simply as the *Seek*, is an old favorite dessert apple. In some sections it has proved to be a reliable cropper, but in other sections it has not been very productive. The tree is medium to large in size, spreading, and moderately vigorous to vigorous. The fruit is usually about medium in size and roundish conical in form. The skin is tough and smooth; in color it is rather a deep yellow tinged with green, shaded and splashed with dull red, and striped with deep carmine. The flesh is slightly tinged with yellow; it is firm, crisp, aromatic, and of good to best quality. The season of this variety in ordinary storage is late fall and early winter, but when properly handled it may be held in cold storage about as late as the Baldwin.

42. Jonathan.—The Jonathan is a variety produced from a seedling of the Esopus Spitzenburg. However, it is more hardy, productive, and shows more health and vigor, and is adapted to a wider range of territory than the Spitzenburg, but the fruit is smaller and is somewhat more deficient in keeping quality. The Jonathan does fairly well in New York and Northern Pennsylvania, but it seems better adapted to the apple-growing regions of Southern Pennsylvania, Maryland, and the Central and Western States, where it is of considerable commercial importance.

The tree is medium in size, is a fairly reliable cropper and comes into bearing rather early. The fruit ranges from small to medium in size; it is from roundish conic to roundish ovate in form. The cavity is acute to acuminate, deep and wide, and is sometimes slightly furrowed. The basin is deep, abrupt,

and varies from wide to moderately narrow. The skin is thin, tough, and smooth; the under color is yellowish overlaid with a lively red that is indistinctly striped with carmine. Often a splash of yellow is seen near the cavity where a twig or a leaf has shaded the fruit. This condition can be seen in Fig. 18, which shows a Jonathan apple at the top of the page; this apple was grown in Pennsylvania. The flesh of the Jonathan is yellowish or whitish, often marked with red. The apples are juicy and spicy, and the quality is very good to best. The season of the Jonathan is from October to some time in January if kept in ordinary storage, and to February or March if kept in cold storage. The fruit is highly desirable for the Christmas trade.

43. Delicious.—The Delicious is a rather new variety of apple that is very promising for commercial planting, especially in the fruit-growing regions of the Northwest. The



FIG. 19

tree is a strong grower and produces a large quantity of pollen; the latter quality makes the Delicious useful for planting with



FIG. 20

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varieties that are deficient in the quantity of pollen produced. The fruit is large to very large and oblong conic in shape. The skin is thin and smooth, almost polished; in color it is a pale yellow overlaid with splashes and stripes of different shades of red. The prevailing color effect is a pleasing red. In Fig. 18 a Delicious apple is shown at the bottom of the page. A characteristic of the fruit is five points that project from the basin, as shown in Fig. 19. The flesh of the Delicious is a pale yellow, tender, and moderately juicy. The quality is of the best, especially for dessert.

44. Rhode Island Greening.—The Rhode Island Greening, commonly known simply as the *Greening*, is the best known green apple in America. It is an important commercial variety in New England, New York, Northern Pennsylvania, Southern Canada, and parts of Ohio and Michigan. In fact, it is about as well known and in as great demand on the market as the Baldwin.

The tree, when properly managed, is a reliable cropper, yielding fruit annually. It is large in size, spreading in habit, and has dense foliage. The fruit is above medium to large in size; it is grass green in color in autumn, later developing a slightly yellowish tinge. The apples are never striped, but occasionally they develop a rather bright cheek. In form they are roundish oblate. The skin is rather thick, tough, and smooth, and is covered with grayish white or russet dots that are more numerous toward the basin than elsewhere. In Fig. 20 a Rhode Island Greening apple is shown at the top of the page. The flesh of the Rhode Island Greening is yellowish, firm, fine grained, and juicy; in quality it is very good. The Greening is highly prized for cooking, and by many is thought to be an excellent dessert fruit notwithstanding the fact that it has a rather peculiar flavor. The Greening is a good shipper, is well known to consumers, and, where the location is favorable, is a profitable variety to grow. Its season is about the same as that of the Baldwin.

45. Northwestern.—The Northwestern, or *Northwestern Greening*, is similar in some respects to the Rhode Island

Greening. The Northwestern, however, is hardier than the Rhode Island Greening, and for this reason has been planted in districts where the climate is too severe for the latter. The tree is hardy and vigorous, and, although it is likely to come into bearing late, is a good cropper, yielding fruit, as a rule, biennially. The fruit is large to very large in size, generally roundish in form, and greenish or yellowish in color. The dots vary from small to large and are conspicuous. In Fig. 20 a Northwestern apple is shown at the bottom of the page; this apple was grown in Iowa. In quality the fruit of this variety is inferior to that of the Rhode Island Greening, ranking only fair for both cooking and dessert. The variety is best known in Wisconsin, Iowa, and Minnesota, where it is grown commercially to some extent. The fruit will keep fairly well in cold storage until April or May.

46. Green Newtown.—The Green Newtown is very similar to the variety known as the Yellow Newtown, which is described later; in fact, it is thought by some horticulturists that one is a strain of the other, and it has not been determined which was the parent and which was the seedling. Green Newtown trees are rather slow of growth, attain fair size, and under favorable conditions come into bearing young; they are good yielders. The tree is slightly drooping in habit. The fruit ranges from moderate to very large in size; it is usually roundish oblate in form; the skin is rather tough and may either be smooth or slightly roughened. The color is generally grass green when the fruit is picked, but the apples are likely to become yellowish on standing. The flesh is either yellowish or tinged with green according to the color of the skin, and the quality is of the best. The apples are highly prized both for cooking and for dessert. The season may extend anywhere from February to April, or May, depending on where the fruit was grown and the method of storage.

The Green Newtown variety is markedly influenced by environment, and the locations where it can be grown successfully are limited. The lower part of the Hudson River Valley in New York, the Piedmont and mountainous regions of Virginia

and North Carolina, and certain localities in California, Oregon, and Washington are favorable for the production of the variety.

47. Yellow Newtown.—The Yellow Newtown variety differs in but a few particulars from the Green Newtown. The tree of the former is slightly more vigorous and in habit it is more erect than that of the latter. The fruit is like that of the Green Newtown, except in color of the skin and in color and flavor of the flesh. At harvest time the apples are yellow, and often there is a pink blush spread over a part of the surface. The flesh is yellowish and the flavor is mild and aromatic. As a commercial variety, the Yellow Newtown is highly profitable. Like the Green Newtown, it is susceptible to environmental conditions and grows well only in certain localities. Its area of production is about the same as that of the Green Newtown.

In Albemarle County, Virginia, the Yellow Newtown grows exceedingly well, and formerly it was thought that the apples produced in this region were a distinct variety, and they were known as *Albemarle Pippins*; this term is still frequently applied to fruit of the Yellow Newtown variety. Hundreds of barrels of so-called Albemarle Pippins are exported to England annually. The beginning of the demand for this fruit can be traced to a peculiar incident. During the first year of the reign of Queen Victoria of England, Andrew Stevenson, a resident of Albemarle County, was Minister to the Court of St. James, and from among the Albemarle Pippins he had shipped to England for his own use, he presented several barrels to Queen Victoria. She was much pleased with the fruit and out of courtesy to him removed from Albemarle Pippins the tax levied on fruit. From that time to the present the demand for Albemarle Pippins has grown steadily in English markets.

48. King David.—The King David is a new variety of considerable promise. It is thought to be a cross between the Jonathan and the Arkansas Black. The tree greatly resembles that of the Jonathan but is said to be more vigorous and hardy. The fruit also resembles that of the Jonathan but

is larger and of a deeper red color. In flavor, the fruit is very rich and spicy. The season of the King David is said to be a little longer than that of the Jonathan. This is a good variety for planting where fruit is wanted for fancy trade or for export.

49. Ben Davis.—The Ben Davis is probably grown over a wider area than any other variety. In fact, it is thought that more Ben Davis trees are grown than those of any other apple. The section best suited to the production of this variety is Virginia, Kentucky, Tennessee, Missouri, Illinois, and Arkansas; however, it has been found to succeed fairly well wherever it has been planted, and many Ben Davis orchards are found in New England, New York, Pennsylvania, and parts of Canada.

The tree of the Ben Davis is medium in size and is rather a rank grower when young; it has coarse, strong wood that will stand under heavy crops. The form tends to be upright and roundish, becoming rather spreading in old trees. The fruit is usually above medium to large in size and roundish conic to somewhat oblong in form. The skin is tough, waxy, bright, smooth, and glossy. The color is clear yellow or greenish, mottled and washed with bright red, and striped and splashed with dark carmine, which gives the prevailing effect of bright deep red or red striped. In Fig. 21 a Ben Davis apple is shown at the top of the page; this apple was grown in Virginia. The flesh of the Ben Davis is whitish, slightly tinged with yellow, firm, and moderately coarse, tending to be slightly tough. The quality, as rated by horticulturists, is good, but to the layman it is only fair or even poor.

The principal advantage of the Ben Davis is the heavy crop it bears. When other varieties are on the market it sells for a low price, but often late in the season dealers get a good price for the fruit. From the standpoint of the apple market it is doubtful whether the planting of Ben Davis should be increased. The season extends as late as June or July if the fruit is kept in cold storage.

50. Gano.—The Gano is an apple of the Ben Davis type, but it is somewhat superior to the latter in quality. It is thought to be a better apple for northern regions like New



FIG. 21

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York and Northern Pennsylvania than the Ben Davis. The tree is usually vigorous and of the same upright spreading habit as the Ben Davis. The fruit is medium in size and roundish conic in form. Often the cavity is slightly furrowed. The skin is smooth and waxy, and is light yellow in color, overlaid with light pinkish or purplish red obscurely striped. Often the red is almost a solid color. The general color effect is a fine clear red. In Fig. 21 a Gano apple is shown at the bottom of the page; this apple was grown in Pennsylvania. The flesh of the Gano is whitish, slightly tinged with yellow, firm, and coarse in texture. The quality is, perhaps, a little better than that of the Ben Davis. The season of the Gano is about the same as that of the Ben Davis.

51. Winesap.—The Winesap apple is one of the oldest grown in America. It is what may be termed a middle-latitude apple and is well known in Virginia, Maryland, West Virginia, Arkansas, Missouri, and some of the Western States. The tree is of medium size, rather vigorous, comes into bearing early, and is usually an annual cropper. The fruit tends to be small, although when grown under favorable conditions it attains a good size. The form of the Winesap is usually roundish, slightly conical, and truncate at the base. The skin is medium thick, tough, smooth, and glossy. The ground color is yellow, or greenish, overlaid with deep red indistinctly striped and blotched with a dark purplish red. The prevailing effect is a bright deep red. In Fig. 22 a Winesap apple is shown at the top of the page; this apple was grown near Selah, Washington. The flesh of the Winesap is yellowish, and sometimes veins of red can be seen running through it. The apples are juicy and crisp, and the quality is good to very good. The ordinary limit in cold storage is April.

52. Black Ben Davis.—The Black Ben Davis is an apple of the Ben Davis type, but is resembles the Gano more than the Ben Davis. The *Black Ben*, as it is often called, is grown to a considerable extent in the Central and Western States. The tree, when young, is upright, but on reaching maturity it becomes rather spreading and dense. The fruit

is medium to large in size, and roundish ovate to roundish conic in form. The skin is thin, tough, smooth, and glossy. The under color is a clear pale yellow, but it is, on well-matured specimens, covered with a brilliant red that becomes a dark purple on the side exposed to the sun. The season lasts until April and May if the fruit is kept in cold storage. In Fig. 22 a Black Ben Davis apple is shown at the bottom of the page; this apple was grown in Washington.

53. Rome Beauty.—The Rome Beauty is an old variety that is commonly grown in the latitude of New Jersey and Southern Ohio; it is grown also in parts of Missouri, and in some of the Pacific Coast States. The tree is not particularly vigorous but attains medium size and comes into bearing early. The fruit ranges in size from medium to very large; in form it is roundish to roundish conic, sometimes slightly oblong. The skin is thick, tough, and smooth. The color is greenish or yellowish mottled with bright red that, on well-colored specimens, deepens to almost a solid red on the exposed cheek. The prevailing color is red mixed with yellow. In Fig. 23 a Rome Beauty apple is shown at the top of the page; this apple was grown in Washington. The flesh of the Rome Beauty is nearly white, with a slight tinge of yellow or green; it is juicy, crisp, of an agreeable taste, and of good quality. The fruit is used for both dessert and cooking purposes. The season of the Rome Beauty extends to about April or May, if the apples are kept in cold storage.

54. Stayman Winesap.—A seedling of the Winesap, known as the Stayman Winesap, is considered by many to be better for general cultivation than its parent. The variety was originated in 1866 from the seed of the Winesap by Dr. J. Stayman, of Leavenworth, Kansas, from whom it derives its name. The tree is fairly vigorous and the form is spreading and rather open. The fruit is from medium to very large in size and is roundish conic to globular in form. The skin is smooth, rather thick, and tough. The under color is greenish or yellowish, often almost completely covered with a dull red over color that is rather indistinctly striped with carmine.



FIG. 22

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FIG. 23

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FIG. 24

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The prevailing effect is a pleasing red. In Fig. 23 a Stayman Winesap apple is shown at the bottom of the page; this apple was grown in Washington. The flesh is yellowish or greenish in color, crisp, and juicy; in quality it is good to very good. The range for planting is about the same as that of the Winesap. The fruit will keep in storage until April or May.

55. Salome.—The Salome variety originated about 1852 in Illinois and has become rather widely disseminated. The tree is vigorous, attains a large size, and is a good cropper, but tends to yield in alternate years. The fruit is usually below medium in size, and is roundish oblate and often elliptical in form. The skin is thin, tough, and smooth; the under color is rather a pale yellow or green, being overlaid with carmine stripes and a blush. Often the apples are marked toward the cavity with whitish bloom. In Fig. 24 a Pennsylvania-grown Salome apple is shown at the top of the page. The flesh of the Salome is yellowish, firm, and moderately fine grained; it is of good to very good quality. The season extends from November to March.

56. Wagener.—The Wagener is an apple of the Northern Spy type, and is much used in New England, New York, and Northern Pennsylvania as a filler in commercial orchards. The reason for this is that the tree is dwarfish in size, and although a rather slow grower, comes into bearing at an early age. The trees are vigorous when young, but on reaching maturity they become rather weak and are short lived. But these qualities do not detract from their use as fillers. The fruit is medium to large in size and roundish oblate in form. The skin is thin, tough, smooth, and glossy. The color is pale yellow covered with a bright pinkish red, striped with bright carmine. The prevailing effect is a bright, light red. In Fig. 24 a Wagener apple is shown at the bottom of the page; this apple was grown near Scranton, Pennsylvania. The flesh of the Wagener is whitish, slightly tinged with yellow, juicy, and tender. Its quality is very good to best, being similar to the Spy in this respect. The season extends from October to February or later. Wageners are in demand on the market



FIG. 25

and command a good price, largely on account of their color and quality. Often they are sold as Spys by unscrupulous dealers.

57. Arkansas.—The Arkansas, known also as the *Mammoth Black Twig*, another apple of the Winesap class, is distinct from the Arkansas Black. The tree is rather large and vigorous, but is inclined to be a shy bearer. The fruit is from medium to large in size, and roundish and often slightly oblate in form. The color is greenish or yellowish overlaid with a dull, deep red, often obscurely striped with darker red. Fig. 25 shows a well-colored apple of the variety. The flesh of the Arkansas is yellowish, firm, and fairly juicy. The apples are good keepers, lasting in cold storage until about May. The variety has been extensively planted in some of the Southern and Southwestern States, but is has not proved to be commercially successful, largely on account of being a poor bearer.

58. Ralls.—The Ralls, also known as the *Geniton* and *Genet*, is a middle-latitude variety that does especially well in the Missouri apple-growing section. The tree is a heavy cropper in alternate years, and alternates probably more distinctly than most other varieties. It is long lived in the Missouri section and does well not only on thin land, but also on heavy bottom land. Its greatest value for the section to which it is adapted is its late blooming habit. Even in the most unfavorable areas it is practically never killed by late freezes; thus even in low bottoms it is almost a sure cropper in alternate years. The fruit ripens very late, and is generally below medium in size, although on young trees it is often above medium; the form is roundish oblate, varying to roundish. The skin is smooth with a yellow or greenish under color that is blushed and mottled with pinkish red and indistinctly striped with dull carmine. This is overspread with a light bloom and broken stripes of whitish scarf skin, which gives the apple a rather dull appearance. The flesh is whitish, firm, and moderately fine grained. The quality of the fruit where grown in Missouri is very good, but when grown in northern latitudes the apples ripen so late that the quality is only medium. In ordinary storage the season is from December to April.



FIG. 26



59. Ingram.—The Ingram, a seedling of the Ralls, originated about 1850 on the farm of Martin Ingram, near Springfield, Missouri. The tree blooms nearly as late, bears fruit of better quality and much better color, is a more rapid grower, and has stronger branches than that of the Ralls; the trees tend to bear in alternate years, but not to such a marked extent as the Ralls. The tree is adapted to conditions such as those found in Missouri; on account of the trees blooming so late, the fruit requires a long season for development and for this reason the variety is not adapted for culture in northern latitudes. The tree is vigorous, with moderately stout branches. The fruit is below medium to medium in size, and roundish conic to roundish oblate tending to be oblique in form. The skin is thick, tough, and smooth. The color is a bright greenish yellow or pale yellow washed, mottled, and striped with two shades of red. In regions where it can reach its best development it is almost entirely overspread with a rather dark red. An Ingram apple that was grown in Missouri is shown in Fig. 26. The flesh of the Ingram is tinged with yellow; it is firm and hard but becomes crisp and tender late in the season. The quality is very good. In Missouri, the season of the Ingram is from December to June. This is one of the best of cold-storage apples, specimens having been kept in fairly good condition for 2 years. It is probably the safest variety that can be planted in the Ozark section, and if the tree is kept pruned rather heavily the fruit will attain a good market size.

60. Roxbury.—The Roxbury is a russet apple that is grown commercially in some sections where the Baldwin, Spy, and Greening are grown. The tree is medium to large in size and fairly vigorous. When grown on rich soil in favorable locations it is generally a reliable cropper. As a rule, this variety is a biennial bearer. The fruit is of about medium size and oblate or oblate conic in form. The skin is sometimes smooth but usually is roughened with a greenish to yellowish-brown russet. Dots of russet or gray are conspicuous on the surface. A Roxbury of good size and form is shown in Fig. 27. The flesh of the Roxbury is yellowish or greenish



and the quality is good to very good. A particular advantage of the variety is that it is a good keeper. The season of the fruit, when it is kept in cold storage, extends from December to as late as July.

61. Golden Russet.—The Golden Russet variety is grown commercially in some sections of the Eastern States. It is an excellent storage variety, sells well in the general market, and is particularly in demand for shipment to northwestern and southern markets. The tree is from medium to large in size, and from moderately vigorous to vigorous. The fruit varies from below to above medium in size. The skin is thick and moderately tender; it is usually almost entirely covered with a greenish or yellowish russet, which, in highly colored specimens, becomes a golden russet with a bronze cheek. The flesh is yellowish, rather fine grained, tender, juicy, and very good. The Golden Russet is valuable as a cider apple. The season is from December to April or later.

62. Pewaukee.—The Pewaukee is a northern-grown variety that was originated by crossing the Oldenburg and the Northern Spy. The tree is vigorous, medium to large in size, and a strong grower. It bears at a fairly early age and with good care is a reliable cropper; it usually bears biennially, but sometimes annually. The fruit is from medium to large in size, and is roundish oblate to roundish ovate in form. The cavity is often very small and shallow. The skin is smooth and rather tough, and is of a grass green or yellowish color that is mottled with orange red and striped and splashed with carmine. The prevailing effect is a mixture of red and yellow, or red and green. Fig. 28 illustrates a Pewaukee apple that was grown in New York State. The flesh of the Pewaukee is whitish, tender, and rather coarse. The quality is fair to good either for cooking or dessert. The season varies somewhat. Often the fruit may be kept in cold storage until April; again it may go down in January or February. For commercial planting, the Pewaukee is not particularly desirable, largely because it is not well known by consumers and therefore is not in much demand on the market.



FIG. 29

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63. Grimes.—The Grimes, or *Grimes Golden*, apple is adapted to middle latitudes and is one of the best quality apples produced. In West Virginia, Ohio, and Indiana many commercial orchards of this variety are proving very profitable. The tree is moderately vigorous, the branches are short, curved, and crooked. It bears biennially, although in some cases annually, and is a good cropper. The fruit is medium to large in size and roundish oblong, often truncate in form. The skin is tough and slightly roughened. The color is deep yellow with scattering pale yellow or russet dots. In Fig. 29 a Grimes Golden apple is shown at the top of the page; this apple was grown in Southern Ohio. The flesh of the Grimes is yellow, firm, tender, and of very good to best quality. The fruit loses some of its quality and is likely to scald in storage. However, the apples can be kept until January or February in cold storage. The Grimes is recommended for commercial planting in the districts mentioned and is worthy of trial in home orchards in these and other similar sections.

64. White Pearmain.—The White Pearmain, or *White Winter Pearmain*, as it is sometimes called, is a favorite dessert apple in some parts of the Central and the Western States. The variety is not grown extensively in commercial orchards, but is much prized for home orchards. The tree is vigorous and wide spreading. In size the fruit is from medium to large, and in form is roundish ovate to oblong conic. The skin is tough and smooth. The color is a pale yellow or greenish shaded with brownish red. In Fig. 29 a White Pearmain apple is shown at the bottom of the page. The flesh is yellowish, tender, and juicy; in quality it is very good to best. The White Pearmain can be kept in storage until about March.

65. Huntsman.—The Huntsman variety, commonly known among growers as the *Huntsman Favorite*, is grown to a considerable extent in Missouri and Kansas. The Huntsman is a dessert apple of high quality, but it is more often found in home orchards than in commercial plantings. The tree is vigorous, and is a late but regular bearer and generally prolific. The fruit is of medium to large size and is roundish oblate



FIG. 30





FIG. 32

and slightly conic in form. The skin is thick but tender, and the color is yellow, slightly greenish, often having a red blush. Fig. 30 shows a Huntsman apple that was grown in Missouri. The flesh is yellowish, rather firm, and juicy; in quality it is good to very good, especially for dessert. The apples can be kept in cold storage until April.

66. Willow.—The Willow, or *Willow Twig*, variety is grown largely in the Mississippi Valley. The tree is large, vigorous, and of upright habit. The fruit is large to medium in size, and roundish inclined to conic in form; sometimes it is roundish oblate. The skin is smooth and rather glossy. The color is a yellowish green, blushed and mottled with red, and striped and splashed irregularly with a deeper red. The general effect is a dull red. Fig. 31 shows a Willow apple that was grown in Missouri. The flesh of the Willow is either yellowish or greenish, firm, coarse, and juicy; the quality is only fair to good. The season extends to May if the fruit is kept in cold storage. The apple is susceptible to scab, blight, and bitter rot, and for this reason fruit growers are not planting it as extensively as in the past.

67. Mann.—The Mann variety is grown on a small scale commercially in New York, the New England States, and Ontario. The tree is medium, to large, vigorous, hardy, a reliable cropper, and a good yielder. The fruit is medium to large in size, and roundish inclined to oblate in form. The skin is thick and tough. The color is a deep green that becomes yellow as the season advances. Fig. 32 shows a Mann apple that was grown in Ontario, Canada. The flesh of the Mann is yellowish and coarse; at first it is hard and firm, but becomes tender on standing. The quality is fair to good, being inferior to that of the Rhode Island Greening. The fruit can be kept until May in cold storage.

68. Stark.—The Stark is a late winter apple that is widely disseminated throughout the United States and Canada. The tree is vigorous, and ranges in size from large to moderately large. It is a reliable cropper and very productive. The fruit is large to medium in size; sometimes it is very large.



FIG. 33

In form it is roundish, inclined to conic, varying to slightly oblate or roundish ovate. The skin is either smooth or slightly roughened with russet dots. In the fall the color is a pale green; as winter advances the color becomes a yellow more or less blushed and mottled and rather indistinctly striped with red. The prevailing color effect is a dull green or yellow mixed with red. Fig. 33 illustrates a Stark apple that was grown in Ontario, Canada. The flesh of the Stark is yellowish and firm; in quality it is fair to good. The apples can often be kept in storage until May; if held until late in the year they are likely to bring good prices.

APPLE CULTURE

(PART 1)

ESTABLISHMENT OF AN APPLE ORCHARD

GENERAL CONSIDERATIONS

1. Size of Orchard.—One of the first questions that comes up in planning an apple orchard is that of the size of the orchard. Before this question can be settled in a satisfactory manner it is advisable to know something of the factors that will determine how many acres of orchard one man can care for, doing the work in accordance with approved methods. It is obvious that in practically all cases it will be desired to make the planting as large as feasible in order that the income may be correspondingly large. At the same time it is evident that there is a limit to the size of orchard that one man can work, and if it is intended that the owner will merely supervise there is also a limit to the acreage he can oversee. Some authorities on orcharding speak of the size of orchard a man can care for advantageously as a *unit*, and there has been considerable discussion as to what acreage constitutes an apple-orchard unit. It is apparent that the question is not one that can be answered definitely, because there are many factors that must be taken into consideration in each case. If a man with limited capital is undertaking to establish an orchard and at the same time to raise grain or vegetable crops sufficient to make a living until the orchard comes into bearing, it is evident that he will be obliged to restrict his planting of trees more than will the man who has capital enough to carry him through the non-productive period of the orchard.

Under some conditions a man may be able to put out a large acreage of trees, employing laborers to do the necessary work; under other conditions labor may be so scarce or expensive that such a plan is not feasible. If good orchard land is abundant in a given locality one man can superintend a much larger acreage than would be possible in a section in which suitable orchard sites are scarce and widely separated. Spraying and harvesting are two orchard operations that require the most labor, and it is imperative that they be performed at the right time. Failure to give them attention at the proper time may result in a heavy loss to the grower. This being the case, it is easy to see that a larger force of men will be required to spray and harvest in an orchard planted to a single variety or to varieties that bloom and ripen at approximately the same time than in another of the same area in which varieties that bloom and ripen in sequence are planted. These and other factors operate to make the question of what constitute an apple-orchard unit so complex that no attempt to lay down certain definite figures can be satisfactory. The prospective apple grower must investigate carefully the conditions that prevail in his locality and in his individual case and decide for himself what size of unit he is warranted in establishing.

2. Some orchardists undertake to determine the size of unit by the capacity of a power spraying outfit, since this is one of the most expensive items of the orchardist's equipment. One power sprayer should handle 30 or 40 acres of orchard in full bearing, except in cases in which the trees have been allowed to reach enormous size and in sections where the land is very hilly. But here again the question of whether or not the orchard is planted with varieties that bloom and ripen in sequence will determine to a large extent the size of unit. As a general rule, a larger orchard unit of summer and winter apples mixed can be handled than of winter varieties alone, not only because there is a wider range of blooming period under the former conditions but also because fewer sprayings are required for the former. In an orchard made up of 10 to 15 acres of summer apples, 15 to 20 acres of fall apples like the Jonathan and

10 acres of very late bloomers like the Ingram that are also late in ripening, the time available for giving any one spraying of the orchard is greatly extended, and as fewer sprayings of the summer apples are necessary, a large orchard can be covered with one sprayer. Furthermore, in such a case the picking would be prolonged through a longer season and there would be less trouble about getting sufficient labor to harvest the crop, so an orchard of this kind could be considerably larger for the same equipment than one made up of varieties blooming and ripening at about the same time.

If considerable other farming is being done, 20 acres would perhaps be an average unit for an apple orchard. With an orchard of this size, the danger that the spraying could not be done at the proper time because of other crops that need attention would probably not be great.

The estimates set forth here are based on the labor required to care for an apple orchard in full bearing. Before the orchard is in full bearing a larger unit probably could be managed with the same equipment.

3. Capital Required.—It is a common mistake among beginners in apple orcharding to overlook the fact that capital is necessary in establishing an orchard. Probably more orchards are failures because of lack of capital than lack of knowledge on the part of the owners.

In estimating the capital necessary for the establishment of an orchard, it is best to consider it independent of the cost of the land, since the latter item is so variable that no estimate that will be of much value can be given. The beginner in orcharding should have, first of all, money enough to secure the land required and the necessary equipment. To this must be added the cost of caring for the orchard each year until it comes into bearing, which may be estimated at about \$20 an acre. In some sections it will be more than this, and in some sections and especially with a man who is exceedingly industrious and a good manager, it will be less. This estimate includes the cost of trees at about 15 cents each, the cost of breaking the ground, planting, and caring for the trees each year. In some sections

the orchard will come into steady bearing at about 6 years of age, in others at 8 or 9 years of age; thus the necessary capital in addition to the equipment would be, for 40 acres, \$800 a year for 5 years, which would be \$4,000, and for 8 years would be \$6,400. If the orchard is located in a section where the cost of maintenance cannot be made from crops grown between the trees, the orchardist should have this amount of capital available in addition to the cost of equipment, except where he does the work himself and can live and keep his team on a smaller income than \$800 a year. If the orchard is in a section where the use of orchard heaters is necessary, about \$2,000 for 40 acres should be added. The following summary of the cost of equipment and maintenance of an orchard of, say, 40 acres will perhaps be of some assistance by suggesting the approximate capital required.

Power sprayer.....	\$ 200 to	\$ 300
Team	300 to	400
Harness, wagon, plows, harrows, and small tools.....	200	
Packing shed, boiling plant, picking and packing utensils.....	200 to	300
Orchard heaters (if required)	2,000	
Maintenance to eighth year	6,400	
		\$ 9,300 to
		\$ 9,600

This outlay would in most cases be sufficient for a larger unit if other conditions are such that they will permit of the handling of a large one. At least two men can be kept busy the year round on a 30- or a 40-acre unit and generally an extra man and an extra team will be required at times. The labor required for picking will vary so much that it is impossible to estimate the number of men necessary. Before the orchard comes into bearing one man with a team could probably maintain it when no special problems like irrigation, etc., are involved.

It will be noted that the estimate given does not include the cost of land or irrigation, neither does it make an allowance for any return that may be secured from crops between the

rows. As mentioned, these may often be made to yield the \$6,400 for maintenance.

In some cases, as for example in sections where apple growing has been uniformly profitable or when the orchardist has the confidence of a money-lending institution or a person of means, it may be possible to borrow a part or all of the capital required. But unless some such favorable condition is present it is not likely that he will be able to obtain an advance of money sufficient to meet his requirements when he has nothing but orchard land and equipment for security.

If the orchard is located in a section where crops between the rows can be grown with a reasonable certainty of a profit before the trees come into bearing, a smaller capital at the beginning may be sufficient than if the growing of crops between the trees is somewhat hazardous. In some sections the soil is so poor that the cost of growing crops between the rows is almost equal to the returns, and in such sections it may be that the only crops that can be at all profitably grown are the small fruits like strawberries, raspberries, etc. These are crops that are somewhat hazardous and in themselves require a considerable outlay of capital, so where they are to be used as a catch crop, more capital for the orchard should be available than where some cheaply grown crop like sweet corn or potatoes can be handled profitably. If a small orchard is being put out and there is a good demand for labor in the community a man may be able to earn enough to care for his own orchard by working for other people and in this case his labor becomes equivalent to capital. If he does not have opportunity or inclination to derive an income from such a source the only way that he could be justified in beginning with a very small capital is to have a certainty of making running expenses for the orchard from crops grown between the rows or on other land.

4. Increasing the Size of the Orchard.—Doubling or trebling the unit for an apple orchard would approximately double or treble the equipment and expenses, except that in some cases five men could probably handle 80 acres of

bearing orchard as readily as three men could handle 40 acres. This would not always be true, and it is not likely that further multiplying the unit would reduce the expense per unit, since with additional men working in different places without a foreman they would not likely do as much work. The experience of practical growers has been that doubling and trebling the unit does not generally reduce the cost per unit.

SELECTION OF SITE

5. Soils Suitable for Apple Orchards.—The selection of a soil suitable for commercial apple orcharding is a matter that should receive careful consideration from the grower. It is of course true that apple trees thrive on a great variety of soils. The man who is planning only a small home orchard may be justified in selecting for this purpose a soil that is not altogether suitable or in making some experimental plantings with a view to determining what the possibilities of a certain soil are with respect to apple production. On the other hand, the man who is putting out a commercial orchard will not, as a rule, care to accept a soil that is defective in any essential requirement nor will he find it advisable to make extensive experimental plantings.

In general, authorities agree that the apple tree thrives best on a deep, well-drained, gravelly or even stony soil. Prof. F. A. Waugh, an orchardist who has made a careful study of the subject, states that as a rule a gravelly loam that is fairly rich in plant-food is the ideal apple soil. Gravelly and stony soils are usually well-drained soils and it seems likely that it is because of this fact that apple trees thrive well on areas in which loose broken stone is abundant; there are, however, sections in which the apple tree does extremely well on sandy loams and silt loams and on almost every other type of soil that is deep and well drained.

Depth of soil is a particularly important requirement in selecting a site for a commercial apple orchard. Although a good, deep soil is desirable for almost any crop, it is all but indispensable for growing apple trees. The chief objection to

a shallow soil is that it affords an inadequate reservoir for the storage of moisture. In the case of annual plants the injury done by a dry year is, as a rule, confined to the year in which the drought occurs, but in the case of trees the injury done on a dry year may destroy the work of a large number of years. The growth of the trees during a given year depends so much on the condition in previous years that the tree is not able to adapt itself to withstanding drought, and therefore is more seriously injured by a drought than annual plants. On a mature tree practically the entire leaf surface is attained within a few weeks after the leaves begin to open and before any one season's drought can shorten the growth. A drought then in a shallow soil would cut short the water supply for the tree with a full leaf surface, so that injury would be much greater than to an annual plant, because the latter would make slower growth during a drought and therefore have smaller leaf surface and would be thus adjusted to withstand the adverse condition. Furthermore, the effect of severe cold seems to be less in a deep soil and the fruit is almost always larger.

For the same reason that a soil should be deep, it should be well drained. Tree roots will go no deeper than the depth to which the soil is well aerated. Further, if the soil at times tends to be mucky near the surface, experience indicates that the tree is much shorter lived. In the Ozark region the red clay subsoil makes ideal conditions for tree roots. The loess soil found along the Mississippi, Missouri, and Ohio rivers is also excellent. This loess soil is considered by some to be the most nearly ideal fruit soil there is. It is rich in plant-food to a very great depth. It is made up of very small particles and yet it drains well, since it contains very small quantities of clay. Although apple trees take away large quantities of soil fertility, the trees will do exceedingly well on a soil that is not considered fertile soil from the standpoint of farm crops. This is probably because of the deep-rooting habit of the trees.

6. Elevation of Orchard Site.—One of the most important factors in determining the success of an apple orchard is the effect of late spring frosts, and the location of the orchard

with reference to the prevention of damage from this influence is an important consideration. It will be much better to have to ship the apples several hundred miles from a section where failures on account of frost are rare than to be in a section where frosts are so common that the crop will be lost so often that no profit will be left after maintaining the orchard, or where great expense is entailed in heating the orchard.

The elevation of an orchard site will determine to a large extent the degree to which late spring frosts will injure the blossoms. Although it is true that, as the elevation of a large area increases the average temperature for the given section decreases, at the same time in any given section on a still, clear night the higher points will be warmer. This is because cold air is heavier than warm air and tends to settle into low places. Thus, in a broken country there are almost always elevated areas where there is less danger from killing frosts than in a level country. On the other hand, in a broken country the valleys are in more danger than the hills because of this settling of the cold air into the valleys. Experience indicates, however, that a wide valley is not likely to be of any benefit in carrying away the cold air, since the wind is likely to stir the cold air up and prevent settling; in the narrow valleys, where the wind must blow across rather than up and down, there will be settling even when there is a good deal of wind. However, on a very windy night there is not a great settling of the cold air and the temperature on the hill top is likely to be nearly the same as that in the valley.

7. Slope of Land.—In another Section it has been shown that the slope of the land may have something to do with the susceptibility of an orchard to injury from spring frosts by affecting the time of blooming. If the slope is rather steep and the trees are large, the trees may bloom later on the north slope than on the south slope, for the reason that every tree will throw a shadow on the tree next north of it, and thus the twigs will not be warmed up by receiving the direct sunlight on warm sunny days. However, if the slope is not steep enough for one tree to throw shadow on another, there will be little

if any difference, since the cold soil on the north is not likely to have much influence on the time of blooming, for it is the temperature of the twigs and not that of the roots that largely determines the time of blooming. The soil remains colder on the north than on the south slope, because each ray of sunlight is spread out over more surface, but if the trees stand erect each one will receive just as direct sunlight on one slope as on the other provided one tree does not cast a shadow over another. In general, a north slope is considered better than a south slope for the reason that the soil on the former is generally richer than that on the latter. Other considerations that are objectionable on a south slope are that the thawing on warm days in winter causes a slipping down the hill of the soil, and further that since the soil is warmer on the south slope the humus is burned out faster in such areas than on a north slope.

8. Exposure of Site.—In choosing a site the exposure may be important in its effect on the temperature, on evaporation, on the number of windfalls, and on the breaking of the trees by winds.

The only time that a windward exposure will affect the temperature of an orchard is when the orchard is in a location like that near a body of water. When the temperature of the water is higher or lower than that of the surrounding country the wind may bring a lower or a higher temperature than that of the orchard. In some cases protection from wind might actually make the orchard colder by deflecting the wind from over the soil of the orchard; and in the late spring when the water is colder than the surrounding country, protection from wind would leave the orchard warmer.

In sections where the trees are frozen up for a long time in winter, protection from wind might prevent winter killing by lessening the rapid evaporation from the twigs during the time they are frozen up and cannot secure moisture from the soil to replace that evaporated. Thus, in a climate like that of Western Nebraska or the Dakotas a windbreak may be beneficial in preventing the drying out of the twigs.

In any climate where there is danger of serious winds in summer, a windbreak would be beneficial in preventing windfalls, and the splitting of trees, but many orchardists prefer to have this windbreak simply an additional two or three rows of fruit trees than to have a windbreak of forest trees near.

A windbreak made of forest trees is sometimes troublesome in bringing and harboring insects and making still-air pockets that increase the danger from spring frosts, and in weakening the growth of the trees near the windbreak. In a region where high winds prevail, a windbreak of forest trees may be desirable, but in the average fruit section it probably is not.

9. Proximity to Markets.—Accessibility to markets is an important factor in determining the success of an orchard, and in selecting a location this should always have careful consideration. In locating for the summer apple business, the distance from market will be of particular importance, since the apples may have to be shipped in refrigerator cars and thus transportation become rather expensive, and of course in supplying any local market the distance that the fruit must be hauled will be of great importance, because hauling by wagon is expensive, and, as a rule, there will be more or less injury to the fruit unless the roads are very good. A difference of a few hundred miles from market, however, amounts to less in determining the success or failure of an orchard enterprise than adaptability of the section to fruit growing. It would be much better to be 1,000 miles from a large market like New York City in a good apple-growing section than to be only 500 miles away where the soil and climatic conditions are not so well adapted to apple growing. However, shipping is one of the greatest expenses of the orchard business and the distance the fruit must be shipped will of course have considerable to do with the net profits. Thus the market in cities in Texas and other southern points where apples are not grown is generally better than the northern markets, and a location in Southern Missouri and Northern Arkansas or other good apple-growing sections near these

markets is desirable on this account. If it is intended to supply a local market, the quantity of apples grown in the neighborhood will be of importance, since the local demand will be limited and the market might be easily oversupplied. In this case a locality in which only a few growers are in the business may be preferable, but where the apples are shipped to the general market it is particularly desirable to be in a section where a great many apples are grown, since a large number of the best buyers will be likely to come into the district and there will doubtless be an opportunity for cooperative marketing. It is also likely that in such a section certain supplies for the orchard, especially the oil for heating if this is necessary, will be some cheaper, because larger quantities will be used.

SELECTION OF VARIETIES

10. The selection of varieties to be planted is one of the important questions the man who plans to establish an orchard is called upon to decide. If the orchard is largely for home use and it is not expected to make it a revenue producer to any great extent, the owner is undoubtedly justified in humoring personal preferences, in planting many different varieties, and in doing considerable experimental planting. Such a course is, however, extremely unfavorable to the best success of a commercial orchard. In the latter case it is particularly important that a proper selection of varieties be made. The important points to be borne in mind in connection with this selection are the growing of varieties suitable to the market available and the growing of varieties adapted to the section in which the orchard is located. It is obvious that market requirements should be considered in selecting varieties for an orchard, for to attempt to force one variety on a market that calls for and is willing to pay a premium for other varieties is to work at a distinct disadvantage. It is, of course, true that if a given variety is not in demand in one market it is always possible for the grower to ship to another market, but it is also true that such a course is likely to involve a more or less heavy transportation charge. Occasionally there are special

considerations that may justify the additional expense, but as a general rule the orchardist will find it advisable to cater to general markets that are reasonably close at hand.

11. The selection of varieties that are adapted to the locality in which the orchard is located is perhaps even more important than the question discussed in the preceding article. It is no more possible to name a best variety of apples or a most profitable variety of apples than it is possible to say that a given soil is best. A variety of apples that does well in one section may be entirely unsuited to another section, hence suggestions for the selection of varieties must be along general lines. Unless the orchardist is already posted as to what varieties are being grown successfully in his section, one of the first steps should be to obtain this information. This may be done by visiting successful orchards in his locality, by correspondence with horticulturists and horticultural associations, and by a study of periodicals devoted to orcharding.

12. In the following paragraphs some general suggestions with reference to standard varieties suitable for various apple-growing sections are offered, but it should be understood that they are, as stated, general suggestions, and that it is expected that the grower will consider them in connection with the other sources of information already enumerated.

Throughout the United States and Canada there is, of course, a wide diversity of soil and climatic conditions, but it is possible to divide this area into sections in which these conditions are, to a greater or less extent, uniform. Different authorities on apple growing make somewhat different divisions of the territory, and it is obvious that the lines of division between two sections cannot be sharply drawn. The classification of sections given herewith is offered merely as a general indication of localities in which approximately similar conditions as to apple growing exist. The varieties mentioned in connection with the different sections are not strictly limited to those sections, and there are likely to be restricted areas in any or all of the sections in which the conditions will differ from the general average of the region. Notwithstanding these departures,

however, the general facts set forth in the classification will serve as a guide to an orchardist in selecting varieties to meet his conditions.

13. Varieties for the New York Section.—By far the most important apple-growing section in North America is what may be designated the New York section which comprises, in addition to the state of New York, the New England states, Pennsylvania, and parts of Ohio and Michigan. The leading variety of the New York section is the Baldwin and two other varieties that are extensively planted and successfully grown in the section are the Northern Spy and the Rhode Island Greening. A very large percentage of the crop is made up of the varieties mentioned, but there are, of course, many other varieties that do well and yield satisfactory returns. Among these may be mentioned Tompkins King, Roxbury, Golden Russet, Hubbardston, Esopus, Spitzenburg, Ben Davis, Tolman Sweet, Twenty Ounce, Seek-No-Further, Fameuse, Yellow and Green Newton, Oldenburg, Wealthy, McIntosh, Alexander, Blue Pearmain and Rome Beauty.

In a considerable portion of Michigan the apples grown are similar to those grown in New York, though a number of Michigan seedlings have come to be of considerable importance, and in the sandy region of Northern Michigan the Oldenburg is grown very largely for marketing in the summer. Wealthy, Fameuse, and McIntosh are also good apples in this section, as they are in Wisconsin and parts of Minnesota. Even in extremely cold regions like the Dakotas these varieties do fairly well, but some hardy Russian varieties like the Wolf River and Alexander are perhaps better for such localities.

14. Varieties for the Virginia Section.—The region to which some authorities have given the name Virginia section comprises New Jersey, Delaware, Maryland, Virginia, West Virginia, and parts of Kentucky, Ohio, and Indiana. Some of the varieties most extensively grown in the Virginia section are the Ben Davis, Jonathan, Grimes Golden, Rome Beauty, York Imperial, Green and Yellow Newton, Albemarle, and the Winesaps. In the higher mountain regions of this

section the Baldwin and other apples that are popular in the New York section are extensively grown. The Grimes Golden is said to reach its best development in the Virginia section. A part of this section, especially Delaware, Virginia, Maryland, and adjoining localities is particularly noted for the production of summer apples.

15. Varieties for the Missouri Section.—The Missouri section includes Missouri, Arkansas, part of Illinois, Kansas, and Oklahoma, and some regions adjacent to these states. The Ben Davis is the predominant variety in the section, and some of the other more important varieties are Jonathan, the Winesap group, Grimes Golden, Ingram, and York Imperial. Probably the best winter apple for this section is the Ingram.

The Ben Davis group includes varieties known as Gano, Black Ben, and Ben Davis. Of these, the latter is probably most extensively planted, but it is possible that the Gano or the Black Ben is more valuable. The Winesap group includes the Winesap, Stayman, Arkansas, Arkansas Black, King David and others.

New varieties that are promising in this section are King David, Delicious, Stayman Winesap, and Magnate.

In Southern Illinois summer apples have come to be extensively grown. Yellow Transparent, Benoni, Sops of Wine, Early Harvest, Maiden Blush, and Wealthy are grown. The Wealthy is also grown extensively in Missouri. Apparently the best summer apple for the Ozark region in Missouri and Arkansas is Benoni, since it seems to be adapted to that soil and withstands spring frosts.

16. Varieties for the Colorado Section.—In the Colorado section, which includes the state from which it is named and adjoining regions in which conditions are similar, there is a very wide range of varieties. The Bellflower is extensively grown, as well as Wealthy, Alexander, McIntosh, Jonathan, Rome Beauty, and the Winesap class. The Wealthy and Alexander are especially well adapted to the higher mountain regions.

17. Varieties for the Northwest.—In the Hood River district of the Northwest, the most important varieties are the Spitzenburg and Newtown. The Ortley is also coming into prominence in this region. In other sections of the Northwest, the Spitzenburg, Newtown, and Ortley varieties are important, as are also the Jonathan, Grimes Golden, Winter Banana, Arkansas Black, Winesap, King David, and Delicious; and the Ben Davis is also a common variety. The Winesap type of apples is grown more in the warmer valleys of the Northwest. In the Bitter Root valley only the hardiest varieties are grown successfully, the two most important being McIntosh and Alexander, though Wealthy and Fameuse are also grown.

SELECTION OF NURSERY STOCK

18. Buying of Nursery Stock.—In most cases the man who is putting out an orchard will find it advisable to buy his nursery stock directly from a nursery, and it is, of course, well to know something of the honesty and reliability of the nurseryman. If it is planned to order from a nursery in any large quantity, it will always be advisable to ask for the wholesale price list and to get quotations from more than one firm, since considerable may be saved in some cases by so doing. The practice of buying from agents and accepting their advice as to varieties, age of trees, and other details is not one that is likely to prove satisfactory. No nursery trees should be accepted that do not bear a certificate from a state or a national nursery inspector showing that the nursery is free from dangerous insects and diseases. The buyer should also insist on getting the varieties he orders. Some nurserymen take the liberty of substituting in case they are unable to supply the variety ordered, and for this reason it is a good plan to specify on each order that no substitution will be accepted.

19. Appearance of Nursery Trees.—A good rule for guidance in the selection of nursery stock is to choose trees that have made a good, vigorous growth in the nursery. Trees that have made a slow, weak growth in the nursery may be as likely to live as those that have made a more vigorous growth,

but the former will probably be a year or two later than the latter in coming into bearing, and, as a rule, the mature trees will scarcely be as good.

The roots of a good nursery tree should be strong and well developed, and there should be, for best results, four or five

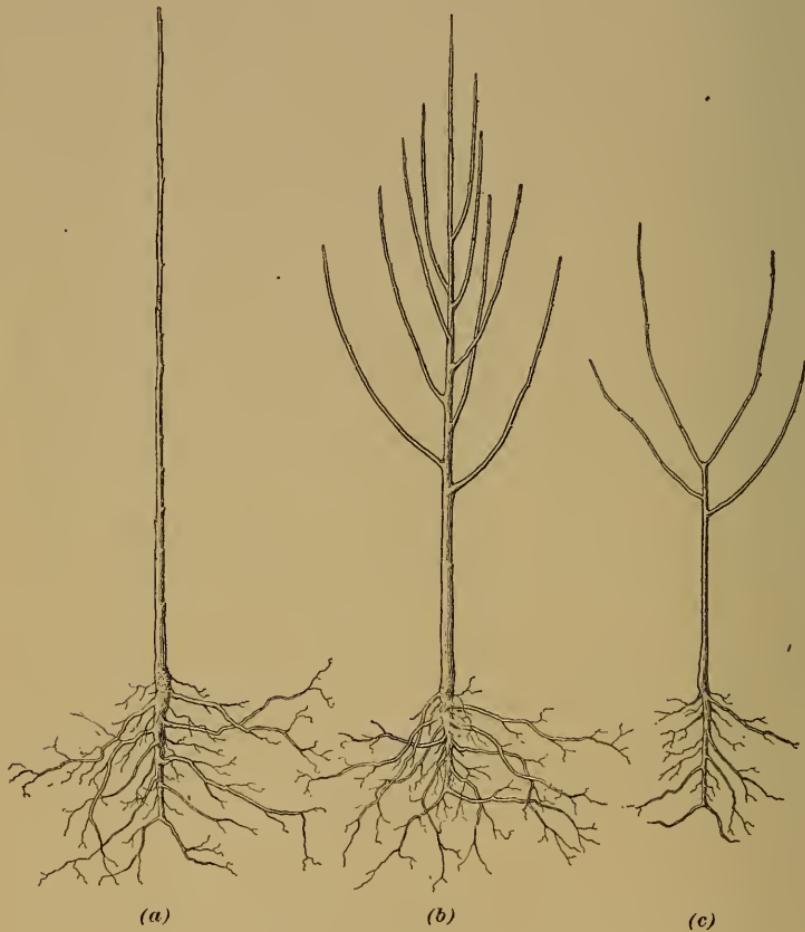


FIG. 1

large rather than a lot of small roots clustered around the old root that formed a part of the graft. In Fig. 1 (a) is shown a desirable 1-year-old tree; in (b) is shown a good 2-year-old tree; and in (c) is shown a 2-year-old tree that has made a slow, weak growth, probably due to a poor soil in the nursery.

20. Age of Nursery Trees.—Beginners frequently make the mistake of selecting 2-year-old trees, regardless of their quality, in preference to 1-year-old trees. A good-sized, healthy 1-year-old tree is better under some conditions than a 2-year-old tree, and some orchardists declare a strong preference for the former. The location and spacing of the branches on a 2-year-old tree will be determined by the condition under which the tree was grown in the nursery. Usually there will be a dense growth of limbs beginning about $1\frac{1}{2}$ or 2 feet up on the main stem, then a space containing no limbs, then another dense growth of young limbs. Such a condition often makes it difficult for the orchardist to start branches exactly where it is desired to have them. A large 1-year-old tree, say 4 feet in height, can be cut back a little before planting, and still be left long enough that the four or five limbs desired can be spaced so that none of them will be closer than 5 or 6 inches from its nearest neighbors. However, a good 2-year-old tree will usually withstand more adverse conditions, especially severe cold if planted in the fall, than will a 1-year-old tree.

21. Northern-Grown and Southern-Grown Trees. Some difference of opinion exists among orchardists as to whether or not northern-grown trees are hardier than southern-grown trees. It may be said, however, that most authorities are agreed that a tree is hardy or tender according to the variety rather than according to where the tree was grown. For example, each Ben Davis tree is a part of the original Ben Davis tree and its ability to withstand cold is determined by hereditary qualities that existed in the original Ben Davis tree rather than by the climatic condition under which a tree was grown in the nursery. Of course, if trees are grown in a southern nursery and continue to grow so late in the fall that the wood does not have time to ripen before freezing weather, they are in no condition to withstand winters farther north. The best plan is to insist on trees that are well matured rather than on trees that have been grown in a certain section.

22. Value of Trees Propagated by Various Methods. Some nurserymen claim that a tree made from a whole-root

graft will be permanently a better tree than one made from a piece-root graft. They base this claim on the fact that a tree from the whole-root graft will have a tap root—that is, a root running straight down from the body of the tree—and will tend to grow deep; with a piece-root graft, the tap root will have been lost and the roots will tend to spread out in the soil. From the description of grafting operations as detailed in another Section, it will be seen that this claim is ridiculous, since in both cases the tap root has been cut; the only difference is that in one case the root has been cut a little shorter than in the other. As a matter of fact, the only advantage of the whole-root graft is to the nurseryman. Sometimes he is able by the system of grafting whole roots to secure a larger percentage of trees that will grade, say, 4 feet or over when they are 1 year old.

Actual experience with whole-root and piece-root trees shows no difference in bearing qualities or ability to root deep in the soil. At the Missouri Experiment Station there are a number of Jonathan trees, one-fourth of which were secured from piece roots taken from the first piece at the top, one-fourth from piece roots taken from the second piece from the top, one-fourth from piece roots taken from the third piece from the top, and one-fourth were from whole roots, the roots being actually whole roots and not large piece roots such as are commonly spoken of as whole roots. In every case the piece-root trees are as profitable as the whole-root trees.

Some nurseries claim better results from budded trees than from grafted trees, the theory being that there is not a permanent union between the stock and the scion in the case of the grafted trees. These claims are usually made by agents who, in many cases, have with them a portion of a grafted tree cut through lengthwise in such a way that the original graft shows and they often emphasize strongly the fact that this has never permanently united but has only been grown over with new wood. As a matter of fact, if a budded tree were cut through to show where the bud was inserted, it would be found that the old dead end of the stock is there just as it is in the case of the grafted tree, and it may be said that there is absolutely no fundamental difference between budded and

grafted trees in this respect. Of course, if the budded tree were budded on a 2-year-old root instead of a 1-year-old root, it should be larger at the end of the first year, and a very large, strong, stocky whip is the most ideal tree to set; but if these can be secured from grafted trees they are equally as good as from budded trees.

23. Home Propagation of Apple Trees.—If a man is sufficiently acquainted with the nursery business, it may at times be profitable for him to propagate his trees, especially if he has limited capital and is doing his own work on the farm. The stocks and scions can be secured much more cheaply than the trees, and he can care for them at odd times or by working overtime. But, as a rule, it is only in case of a man who has had considerable experience in this work that this course would be advisable, and then it will not pay unless he has a soil that will grow a strong, young tree. If a man is hiring his work done it will certainly not pay, for the reason that by growing them on a small scale the work will have to be done in a less efficient manner or more expensive manner than if they are grown on a large scale as in a nursery. Further, if there is lack of skill on the part of the workmen so that only a small percentage of the trees grown make good trees, home propagation is likely to be extremely unsatisfactory.

PLANTING OF APPLE TREES

24. Time of Planting.—Apple trees may be planted in the spring or in the fall, and there has been much discussion as to whether spring planting or fall planting is best. In Canada and the northern part of the United States away from the Great Lakes, spring planting will probably always be most advisable, for in such climates there is likely to be considerable winter injury to the young trees planted in the fall. Trees planted in the spring escape some adverse conditions that must be endured by trees planted in the fall, and unless there are some distinct advantages in fall planting, spring planting is usually preferred. However, it is well known that soil at a

depth of a few inches remains warm in the fall long after the air becomes too cold for plant growth. Then, unless the roots have a rest period like the tops, it would be expected that some root growth would be made in the fall and thus the trees would be ready to start off into a more rapid growth in the spring. This matter has not been tested as extensively as it should be, but a few tests have indicated unquestionably that in a mild climate such as that in Missouri, Illinois, Virginia, etc., there may be root growth in the fall. The Missouri Botanical Garden, cooperating with the Nebraska Experiment Station, found that in some cases root growth was made by apple trees in the fall when the trees were planted early in the fall, and the Missouri Experiment Station has confirmed this finding.

The important test of fall planting, however, is the growth made by the trees the season following as compared with spring-planted trees. As the result of the experiment at the Missouri Botanical Garden, the following figures were given for the growth of the roots and top: The trees were dug on July 2 and top and root growth measured. In the case of Ben Davis apples the average top growth for fall-planted trees was 14 inches, and the root growth 8 inches; for spring-planted trees the top growth was 12 inches and the root growth 5 inches. In the case of fall-planted Shackleford trees, the top growth was 17 inches and the root growth 5 inches; for spring-planted trees the top growth was 7 inches and root growth 9 inches. In the case of fall-planted Winesap trees the top growth was 12 inches and the root growth 8 inches; for spring-planted trees the top growth was 7 inches and the root growth 6 inches. In the case of fall-planted Oldenburg trees the top growth was 7 inches and the root growth 7 inches; for spring-planted trees the top growth was 10 inches and the root growth 8 inches.

25. In experiments conducted at the University of Missouri beginning in 1908, the twig growth was measured and the diameter of the trees was determined by means of calipers in the fall of 1909 after all growth had ceased. The average linear growth of the fall-planted trees was $224\frac{7}{10}$ inches per tree, and the average increase in diameter was $\frac{13}{16}$ inch; the

average linear growth of the spring-planted trees was 124 inches, and the average increase in diameter was $\frac{1}{6}$ inch. In the season of 1910, the total linear growth of the fall-planted trees was $80\frac{1}{4}$ feet and the average increase in diameter was $1\frac{9}{32}$ inches; the average linear growth of spring-planted trees was $63\frac{5}{12}$ feet, and the average increase in diameter was $1\frac{1}{4}$ inches. It will be seen from this that the fall-planted trees showed remarkably better growth than the spring-planted trees.

In the latter experiments the trees planted in the spring had the best of conditions through the winter, which was a very mild one; the trees came through in excellent condition, were left standing in the nursery where they grew, and were transplanted from the nursery to the orchard, so that there was the least possible shock from the transplanting.

Such a course as this is seldom if ever practicable in the case of an orchardist buying trees from a nursery. Trees purchased for spring planting are almost always those that have been dug by nurserymen the preceding fall and stored in bins, cellars, or storehouses through the winter. Although this method of handling trees is absolutely necessary in any nursery that does a large business, it is objectionable for the reason that the trees are kept at a comparatively high temperature during the winter and the process of respiration that goes on under this condition tends to use up the plant-food stored up in the tree, and in this way the food available for spring growth is reduced. In this respect fall planting is preferable to spring planting, for fall-planted trees do not pass the winter in storage but in the orchard, where the temperature is not favorable to respiratory action, hence the supply of plant-food is not materially reduced. However, it is never advisable to plant in the fall if the soil is very dry. Under such conditions there is a risk that the soil will continue dry and in this case the trees are likely to die during the winter. If the soil is in moist condition at the time of planting, however, there is little danger that it will become too dry for the trees during the winter, since the soil does not dry out greatly through the winter.

26. For spring planting, which will in most sections of the United States and Canada be more satisfactory than fall planting, nursery stock should be ordered the preceding fall, and it is likely that in most cases fall delivery of the stock will also be advisable. In extreme northern sections fall delivery may not be advisable, because where winter temperatures are extremely low there is a better chance of the trees enduring them without injury in the nurseryman's storehouse than in a cellar or improvised storehouse belonging to the orchardist. However, in fruit sections where the winters are not so rigorous, the trees can usually be kept through the winter in better condition outside than in the nurseryman's storehouse. Furthermore, by ordering in the fall, the buyer is more certain to get the trees grown by the nursery from which he is ordering, and can thus know something about the conditions under which they are grown; in the spring the nursery is likely to be out of certain varieties that may be desired and in such cases the trees would perhaps be secured from some other nursery.

27. Some special precautions in the storage of nursery stock between the time of delivery and the time of planting is usually necessary. In most cases trees will be received from the nursery all the way from one week to several weeks before it is desired to begin planting. But even if the orchardist is ready to begin planting the very day the trees are received it will probably be necessary to store some of them while others are being planted, and unless this storage is under suitable conditions great injury may be done to the young trees. Orchardists commonly resort to what is known as *heeling-in* as a means of preventing injury to nursery stock when it is not possible or advisable to plant it immediately on its receipt from the nursery.

To heel-in trees, a trench is dug with a straight side against which the roots are placed and a slanting side on which the tops lie, as shown in Fig. 2 (a). This trench should be dug approximately 1 foot deep, in a well-drained place. All bundles of trees should be opened and the trees distributed along the

trench so that the earth can be packed firmly around each tree. The soil should be filled in over the roots and up at least 6 or 8 inches on the trunks. A row of nursery trees heeled-in according to the plan described is shown in Fig. 2 (b).

It has been observed that few men will take as much care to heel-in trees as should be taken, and doubtless many trees

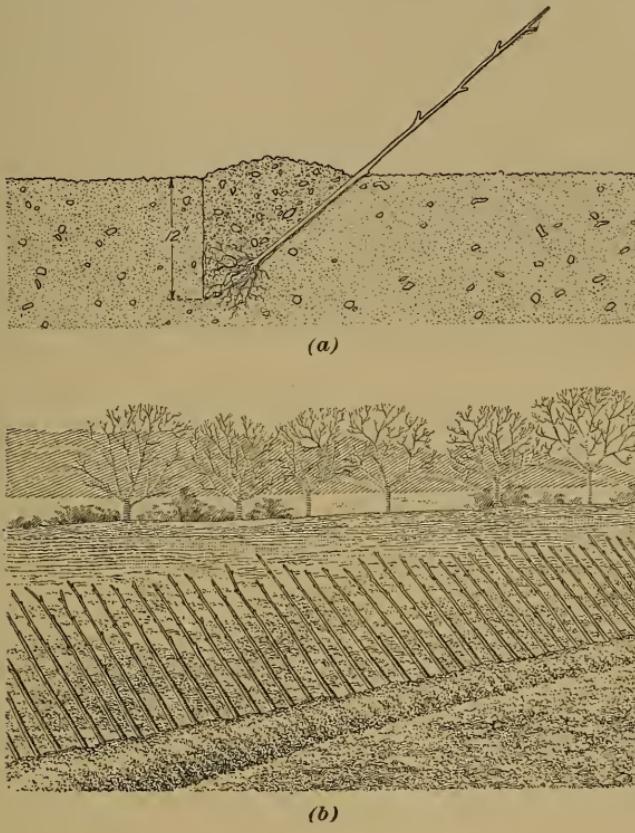


FIG. 2

are seriously injured in this way. If a tree is thus injured it may, in time, recover from the effects, but it can scarcely make as good a tree as if proper attention had been given to the details of heeling-in.

28. Sometimes, when the trees are secured in the fall and well-drained soil is available, it pays to cover both the roots and the tops of the trees. The advantage of this is not alone

in preventing freezing, but also in preventing the starting of the trees into growth by warm days in winter. Heeled-in in this way they do not reach a temperature above that of the soil, which, during the winter, is never high enough to start growth. This is a very desirable method in southern apple-growing sections to prevent starting growth during winter if the trees are not set in the fall, and is also very desirable in extreme northern sections as a means of preventing winter injury to the trees. But, as stated, it is not permissible except in localities where well-drained soil is available.

29. Distance for Planting Apple Trees.—The question of proper distance for planting apple trees is one that deserves careful consideration by the man who is putting out an orchard. Undoubtedly many beginners make the mistake of getting the trees close together. With average varieties, 25 feet apart each way may be considered the minimum distance, and 50 feet apart each way is about the maximum, but this latter distance is certainly too great if it is intended to keep the trees down to manageable size. In rich soils probably 35 feet may be taken as an average distance for planting, although in many soils this may be a greater distance than is necessary if the trees receive the proper repressive pruning. It is unquestionably a serious matter to get trees planted too close. It is not uncommon to see orchards in which the trees are so close that most of them fail to set good bloom, and in sections in the same orchard where a few trees are missing the trees that had more room may have set a good crop of bloom. Just what the distance should be under good system of repressive pruning has not been carefully determined, but experience indicates that an average of 25 feet for thin hill soil will give desirable results; for a soil where trees make a rather vigorous growth, 30 or 35 feet may be taken as a more desirable distance.

SYSTEMS OF PLANTING

30. A number of different systems of planting with reference to the number of trees per acre, the spacing of trees in the rows and the rows in the orchard, are in use among practical

orchardists. The most important systems will be described in succeeding paragraphs, but no attempt will be made to enumerate all of the various modifications of these systems that are made to meet special conditions. It is well for the beginner to study the plans outlined and determine for himself which is best suited to his conditions, for it cannot be said that any one is unqualifiedly best.

Of the planting systems that are described subsequently some permit the planting of a greater number of trees on a given area than others. In Table I are given figures that will enable an orchardist to determine approximately how many trees may be planted on a given area by the various systems. In the case of small plantings or plantings on plots of irregular shape it may not be possible to get the full number specified in the table, but except under such conditions the figures are accurate enough for practical purposes.

TABLE I

NUMBER OF TREES TO PLANT PER ACRE BY VARIOUS SYSTEMS

Distance Apart	Square System	Quincunx System	Hexagonal System
16×16	170	303	196
18×18	134	239	154
20×20	108	192	124
22×22	90	148	104
24×24	76	132	87
25×25	70	125	80
26×26	64	114	74
28×28	56	100	64
30×30	48	85	55
32×32	43	76	49
33×33	40	71	46
36×36	34	60	39
40×40	27	48	32
45×45	22	39	25

31. Square System.—Doubtless the system most commonly used is what is known as the square system, in which the trees are arranged in squares. In Fig. 3 is shown a small tract laid out for planting trees by the square system, with some of the trees in place at *a*. The distance between the trees in a row is the same as the distance between rows. As before stated, this system of planting is extensively followed, and its simplicity makes it well adapted for inexperienced orchardists. Nevertheless, it has its disadvantages, one of the chief of which is the fact that it does not distribute the trees evenly over the area planted. The trees are all the same distance apart in the rows

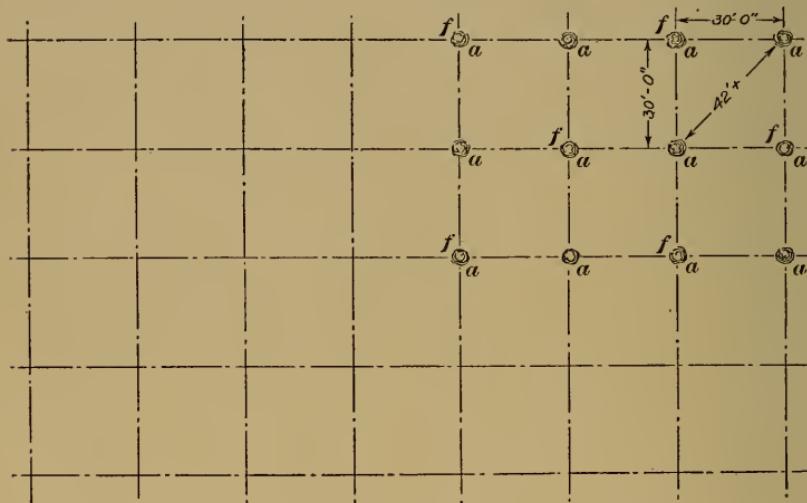


FIG. 3

and cross-rows, but in a diagonal direction the distance between trees is considerably greater. For example, in Fig. 3 if the trees are planted 30 feet apart in the rows, the rows will also be 30 feet apart but the distance between alternate trees in two adjacent rows will be somewhat in excess of 42 feet, and if the trees are planted 40 feet apart in the rows the diagonal distance between trees will be upwards of 56 feet.

If fillers, which subject is discussed elsewhere in the Section, are used in the square system of planting, one plan is to alternate fillers with permanents in each row. Thus, in Fig. 3 the trees marked *f* would be fillers. When the fillers are removed

the permanent trees are still in the square system but the rows and cross-rows will run diagonally with the original rows and the distance between rows and trees will be the diagonal of the original squares. Other methods of planting fillers in the square system are discussed under the subject of fillers.

32. Quincunx System.—A plan of orchard planting known as the quincunx system is in favor with some orchardists, but it cannot be said that the system is extensively used. As suggested by the prefix *quin*, meaning five, the trees are planted in fives. Four trees are planted in a square as in the square system and a fifth tree is placed in the center of the square. Fig. 4 is a diagram of a field partly lined off to indicate the

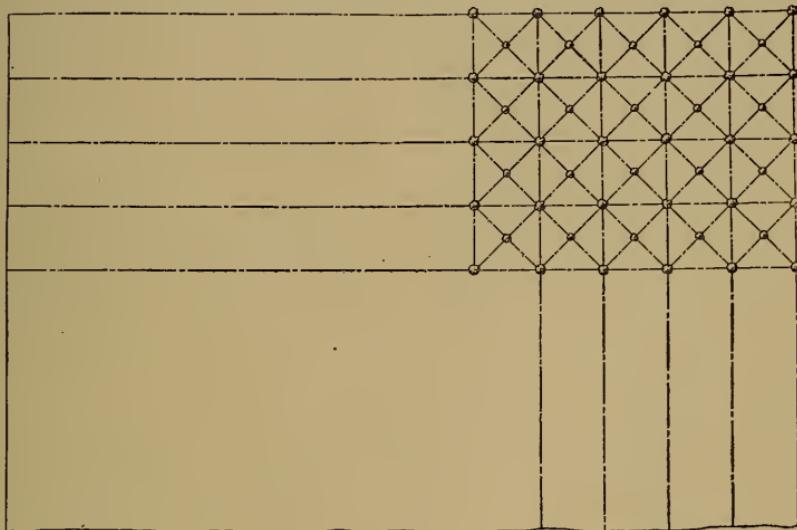


FIG. 4

points at which trees are to be planted. When this plan of planting is followed the usual course is to set permanent trees in the corners and a filler in the center of the square. It will be seen from the diagram that after the removal of the fillers the remaining trees are in the square system. The distance between trees in the square will be the same and the distance between the filler and the trees in the square will be one-half of the diagonal of the square. Thus, if the trees are 30 feet apart in the square, the diagonal will be about 42 feet and

the center tree will be a little more than 21 feet from each corner tree.

33. Hexagonal System.—Another plan of orchard planting is known as the hexagonal system. By this system the trees of the second row alternate or break joints with those of the first row and those of the third row alternate with those of the second. The trees are all the same distance apart, but the distance between the rows is less than the distance between trees in the rows. The diagram in Fig. 5 will show how this condition is brought about. In this case it is assumed that the trees are planted 30 feet apart in the row. The first tree in the second row is set opposite a point midway between the first and the second trees in the first row and 30 feet from each of them. The second tree of the second row is set opposite

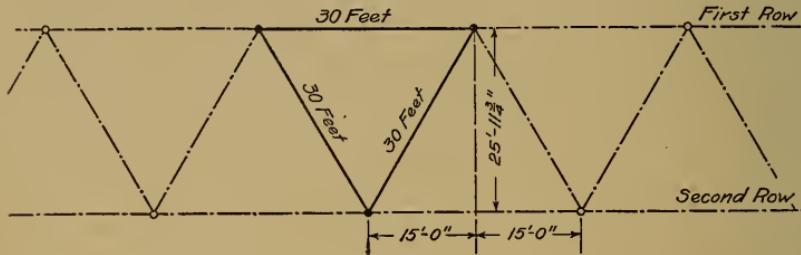


FIG. 5

a point midway between the second and the third tree of the first row and 30 feet from each of them, and the same plan is continued throughout the orchard. Each tree is 30 feet from adjacent trees in the same row and also 30 feet from adjacent trees in adjoining rows, but the distance between the rows themselves is a little short of 26 feet. This system permits the planting of about 15 per cent. more trees on a given area than the square system.

The hexagonal system of planting is desirable for the reason that it distributes the trees evenly over the field, which is not the case in either of the systems previously described, but it is objectionable if fillers are to be used, because in this case it is difficult to place the fillers in such positions as to leave the permanent trees in a desirable arrangement after removing the

former. One of the plans that will leave a regular arrangement is to make each alternate row all fillers and alternate fillers with permanent trees in the remaining rows. Such an arrangement is illustrated in Fig. 6, in which the large trees represent permanent ones and the small trees are the fillers. An examination of the diagram will make it clear that the removal of all the fillers sacrifices such a large percentage of the trees in the orchard that such a plan is obviously objectionable. As a means of avoiding this sacrifice different methods of thinning the trees are frequently resorted to and often the result is that

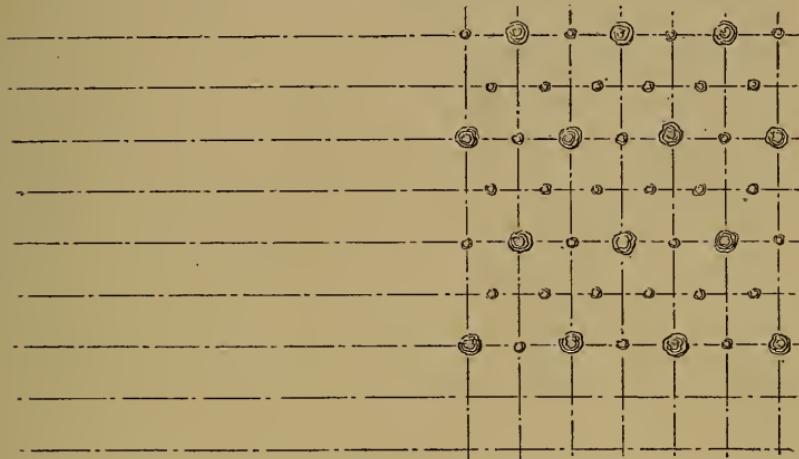


FIG. 6

some fillers are allowed to remain so long that many of the trees are seriously injured by crowding.

34. Combination Systems.—Not infrequently a combination of two of the systems described is found to be better adapted to the needs of the orchardist than any one of them alone. One such combination plan is described herewith, but others may be worked out. The plan referred to is illustrated in Fig. 7, from which it will be seen that the planting is in the square system, with trees 20 feet apart. In the odd-numbered rows, that is the first, third, fifth, etc., fillers are alternated with permanent trees. In the even-numbered rows fillers and half fillers are alternated, the term half filler signifying a tree

that is to remain in the orchard longer than a filler but is ultimately to be removed in order to give the permanent trees room. In the diagram, permanent trees are indicated by *p*, half fillers by *h.f.*, and fillers by *f*. The fillers may be taken out

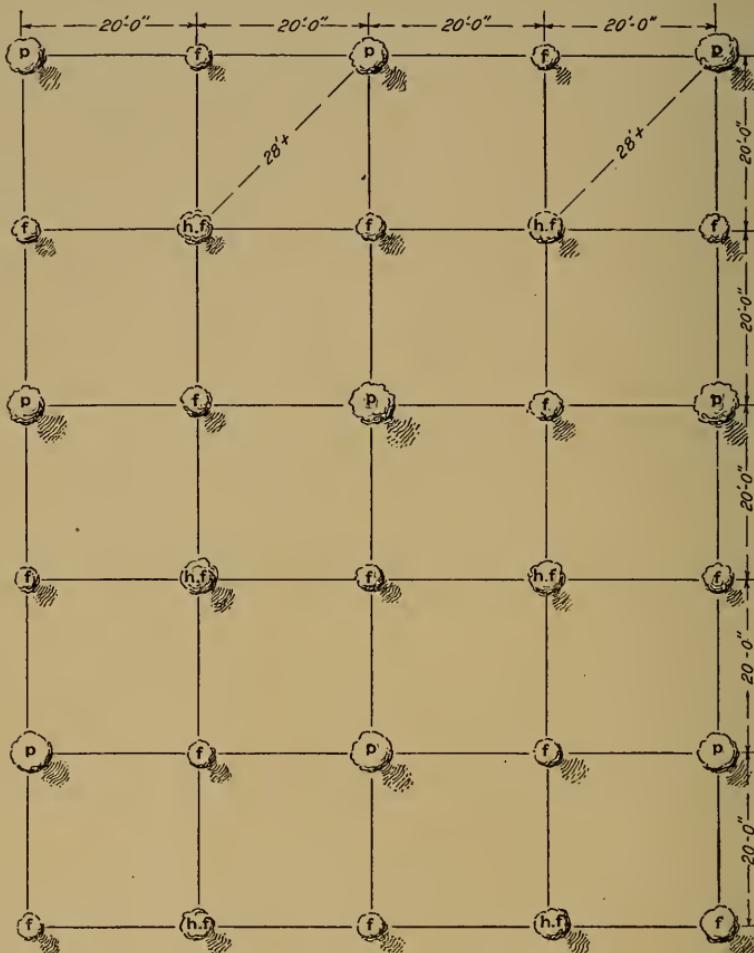


FIG. 7

by removing alternate diagonal rows. When this is done the remaining trees are in the quincunx system. Later, when the half fillers are removed, the remaining trees are in the square system, the trees being 40 feet apart. A point in favor of this system of planting is that if the permanent trees for any

reason fail to make a satisfactory showing before the fillers are removed the latter may be retained as permanent trees and the unsatisfactory trees removed.

USE OF FILLERS

35. The interest, taxes, and cost of cultivating 40 acres of land with, say, 50 trees to the acre will be as much as with 100 trees to the acre, and while the trees are young the expense of pruning and spraying is comparatively small. If no profitable crops other than fruit can be grown between the rows, and this will be the case in some hilly, stony land, it may sometimes be desirable to plant what are known as fillers—that is, plant other trees in addition to those it is intended to leave permanently. These fillers may be of the same variety as the trees meant to be kept permanently, or they may be some other variety that comes into bearing earlier. In all cases the intention is to get as many crops as possible from the fillers and when the trees get so they will interfere, to cut out the fillers, leaving only the permanent trees. It is obvious that the use of fillers may materially increase the income from an orchard during the early years of its life, but there may be another advantage. For example, a man may not be certain which of two varieties he prefers to have as his permanent trees. If he plants them alternately in the row each of them will be better known by the time they come into bearing and he can be more certain which he prefers to keep for his permanent trees. The danger, however, in the use of fillers is that if the orchard containing fillers is profitable, the orchardist will be extremely reluctant to cut the latter out soon enough and may leave them until the vigor of the permanent trees is impaired or the form of the trees injured.

Some plans for the planting of fillers in an orchard have been suggested in connection with the descriptions of the various systems of orchard planting, but others may be used.

If it is planned to use the square system, the fillers may be planted in the row in one direction, and usually the rows are best left the full distance apart in the other direction. Then,

supposing that the permanent trees are 30 feet apart, the rows would be 15 feet apart one way and 30 feet apart the other, as in Fig. 8. It is possible, also, to insert the fillers so that the temporary planting will be in the quincunx

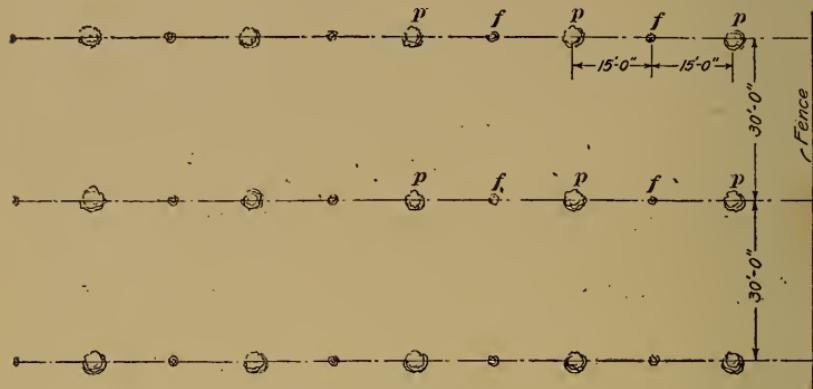


FIG. 8

system and the permanent orchard, after the removal of the fillers, will be in the square system. Thus, if the permanent trees are 30 feet apart each way, a filler may be planted in the center of each of the squares, which will give a quincunx system,

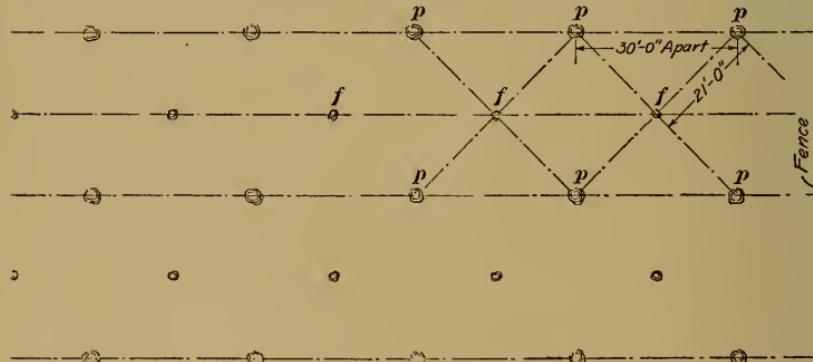


FIG. 9

as shown in Fig. 9, and when it is necessary to cut out the fillers, it will be an easy matter to simply cut out these complete rows. By this system there is the further advantage that no trees of the fillers will be closer than 21 feet from the permanent trees. If an orchard is on hill land, however, this may

necessitate temporary plowing in the wrong direction over the hill. In this case planting between the trees in the permanent rows would perhaps be preferable.

In planting an orchard that is to contain fillers, it is advisable to plant one variety at a time, thus reducing the chance for mistakes.

36. Peaches as Fillers.—Sometimes, instead of using different varieties of apples as fillers, peaches are planted between the apple trees. Advocates of this practice point out the fact that, as the life of the peach tree is much shorter than that of the apple tree, the former may go through its full bearing period before it needs to be cut out of an apple orchard. If the peaches and apples are to receive the same kind of cultivation, this practice may be desirable. However, it necessitates going into the orchard at different times for the spraying; that is, the apples would be sprayed at one time and the peaches at another, or with a different mixture. A further disadvantage is that the land where an apple orchard is to be located will seldom be altogether desirable for peach growing. Furthermore, it is likely that in many cases the apple trees will be in the way at the time of picking the peaches. These objections may not be serious, and in some cases it may be desirable to plant peaches or some other stone fruits, as fillers in an apple orchard, but orchardists who have tried the plan have found various little inconveniences that they did not expect, and have generally found it undesirable to mix these fruits in the same planting.

37. Pears as Fillers.—Pears may at times be used for fillers, since pear trees tend to grow upright. However, there are some objections to this practice. One of these is that pears are almost as long-lived as apples and do not come into bearing much earlier. Another is that if the apples are varieties that are subject to blight, there would be a very great disadvantage in having pears in the orchard, since they may infect the apple trees with the disease.

38. Small Fruits as Fillers.—In sections where small fruits can be grown profitably, they are planted between the

trees instead of using tree fruits as fillers. The advantage of this plan is that the orchardist can begin to get something from the small fruits much sooner than from the tree fruits; and they are free from some of the disadvantages of tree fillers; especially, there is no danger that they will not be cut out in time. Some orchardists have become wealthy on the strawberries grown between apple trees before they came into bearing, and thus if for any reason, the grower should fail to secure profits from the trees, he is still financially ahead. Strawberries are desirable in an orchard, since they require the cultivation that is adapted to the requirements of the orchard, and are not greatly injurious to the soil. Strawberries, however, are profitable only where the grower is reasonably near a local market so that they can be shipped by express or hauled into market, or in a section where there are many other people growing strawberries and the growers can cooperate in getting their fruit on the market.

Blackberries, also, have been grown very satisfactorily between apple-tree rows, but they are not as desirable as strawberries, since they present more difficulty in getting through the orchard for spraying, etc., and in most sections they are not as profitable as strawberries.

Other bush fruits have been used with various degrees of success. Some orchardists grow gooseberries in an orchard, and find them fairly satisfactory. The shade afforded by the trees seems in some cases to benefit the gooseberry plants, so that they make a better growth than they would on open ground.

39. Removal of Fillers.—The question of tillage after the trees begin to reach good size brings up the question of when to remove fillers, if temporary trees have been used between the permanent ones. The general advice may be given to cut out the fillers as soon as the outer spread of their branches begins to reach the outer spread of the branches of the adjacent trees. The tendency on the part of the grower is to allow the fillers to stand too long; he wants to get one more crop from them. Frequently, they are allowed to remain until

they themselves are crowded so they cease to produce well and until in turn they crowd and injure the permanent trees. The orchardist should be prepared to remove the fillers promptly as soon as the permanent trees need all the room. Ordinarily, it is a simple matter for the orchardist to tell by observation when two adjacent trees begin to interfere with each other's best development.

METHODS OF PLANTING

40. Plan of the Orchard.—In laying out a large orchard, it is not best to have the entire orchard in one block; it should be laid out into several blocks with roadways around them. Usually there should be roadways around every 40 acres and in addition to this there should be a wide row probably every eight or ten rows. For example, if the distance the trees are set is 25 feet, probably the tenth or eleventh row should be 35 feet, or if the trees are to become large and are set 35 feet apart, the distance between the tenth and eleventh rows should be 40 feet, though in many cases with the trees 35 feet apart they will not become so large that these wider rows will be necessary.

There are several reasons for planting an orchard in blocks of about ten rows as suggested. In hauling out the brush from pruning, it is often practical to use a hay frame and haul large spreading loads. In this case hauling between the ordinary orchard rows would injure some of the limbs. Furthermore, it is convenient to get through with loads of fruit if wider roads are left at intervals. Another reason for planting the trees in blocks is to secure pollination. Many of the varieties used commercially must be pollinated from some other variety. Thus, with the Jonathan, it is necessary to have some variety like Ben Davis, Delicious, or Wealthy to pollinate it. It is best to alternate in blocks rather than in rows for the sake of convenience. Ten rows is here suggested as a size of the block, because so far as experience indicates, five rows seems to be as far as pollination is satisfactorily accomplished. In a planting of ten rows of Ben Davis or Delicious, and ten rows of Jonathan, then ten rows of Ben Davis or Delicious, and so on,

there will be five rows of Jonathan pollinated well from the other variety in each direction.

41. Preparation of Soil for Planting.—In planting young trees, it is desirable to secure vigorous vegetable growth just as in the case of corn or any other crop that may be grown. It is therefore desirable to have the land in as good a condition for rapid vegetative growth as it is possible to get it without the expenditure of an excessive amount of money. There may be occasional cases where it does not pay to go to the expense of working the land into a good state of fertility and cultivation before planting, particularly if the soil is light and gravelly. In many cases, even though the soil is very poor, an excellent growth can be secured on the young trees by the use of fertilizers. However, in the case of a heavy clay soil that is badly worn, the fertilizers do not show the immediate benefits that they do with light soils. For this reason it is more important with clay soils to get the soil into a good state of fertility and cultivation before the orchard is planted, even if to do this it is necessary to grow crops like cowpeas for a year or two before planting the orchard.

42. Most orchard soils are timber soils rather than prairie soils, and if it is new land, clearing will be the first operation in preparation for orchard planting. If the timber is very large and the soil rich and the style of orcharding is to be intensive, that is if a good deal of money is to be expended on an acre and there is rather certain prospect for a good return, it will pay to get the stumps out of the land while clearing. In this case the cost of clearing is high, particularly if there are many large trees. In certain districts of the Northwest where clearing the land of the stumps is practiced, the cost varies from \$75 to \$200 an acre. With many hill soils in some apple sections of the country, such an expenditure would not be justified by the returns that can be hoped for from an acre. Where the land is merely cleared without pulling or blasting the stumps; the cost of clearing will range from \$8 to possibly \$40 an acre, depending on the kind of timber. In some cases the timber on the land will pay for the clearing, though with a

great deal of orchard soil the timber on the land is not valuable.

For best results the ground should be broken deep before the planting of the trees. As a rule, it may be said that the heavier the clay, the deeper it should be broken, and on an average from 5 to 7 inches would be approximately the proper depth to break.

Tile drainage is not generally necessary in an orchard, because soils that are of such a nature as to require such treatment are, as a rule, unsuitable for orchard purposes. Furthermore, tile drainage is likely to be rather inefficient in an orchard, for the reason that the roots of the trees will penetrate the drains and clog them.

43. Trees that are to be planted in the spring should be set out as early as possible, and, as it is a well-known fact that fall-plowed land becomes warm and dry enough to work in the spring sooner than spring-plowed land, the ground should be broken in the fall, and, if possible, it is advisable to leave it rough until spring. It is usually better, just before planting time in the spring, to work the ground down thoroughly, not only so it will be in condition that the trees can be set more easily, but because thoroughly worked-down soil makes marking off of the land much easier and much more accurate.

If fall planting is to be practiced, it is better for the soil in most cases, especially on hill land, if it can be left rough after plowing. If it is worked down smooth in the fall there is likely to be more or less injury from settling down the hill in winter and also from washing; furthermore, the soil will not work so well in the spring. More care will be necessary in setting the trees if the ground is not harrowed down thoroughly in the fall when planted, but they can be set in this way and the additional cost is not great enough to pay for working the soil down in the fall and certainly not great enough to pay for the cost of working it down in the fall and breaking it again in the spring. If a crop is to be grown in the orchard this breaking in spring would certainly be necessary, since the ground will settle much more if worked down in the fall than if it is left rough. However, under some conditions it will be nearly impossible to get

straight rows at the time of planting if the soil is left very rough. In this case a light harrow should be used that will only level off the rough places without working the ground deep.

In an old, worn soil in which for any reason the trees will not respond readily to a small, inexpensive quantity of fertilizer applied to them, it may in some cases pay to summer fallow, that is, to let a growth of weeds get started and plow them under during the summer, letting the soil stand bare until time to plant the trees. Such practices as these may be further desirable, both in clay soil like that mentioned, and in a very poor, sandy soil in which it is imperative to have a certain quantity of vegetable matter worked into the soil to get satisfactory growth.

44. Preparation of Nursery Trees for Planting.—At time of planting, a certain amount of pruning will be necessary on both the top and the roots of the trees. Pruning of the top is required, first, for the reason that it is necessary to reduce the evaporating surface of the tree, since the ability of the plant to secure water has been reduced by the breaking up of the root system in transplanting. If no pruning were done the leaf surface would become disproportionate to the root system and consequently evaporation from the leaves would be much more rapid than absorption by the roots. Another consideration that requires pruning of the top is that an unpruned tree is much more likely to be affected by strong winds than one that has had a part of the top removed, for the roots, not being well established, do not afford a secure anchorage and the tree is likely to be blown to an inclined position. If the top is reduced there will be less leaf surface exposed to the wind, hence trees so treated are able to withstand strong winds. A third object of pruning at this time is to remove undesirable limbs and leave only those that are well spaced and that will give a mature tree of the desired form.

Small 1-year-old trees usually require nothing more than cutting off the end, and if the wood has ripened up well in the nursery even this may not be necessary. Large 1-year-old trees should be cut back to a 3-foot or a $3\frac{1}{2}$ -foot length, as shown at a

in Fig. 10; 2-year-old trees, however, require more pruning. In general, they should be cut back to $3\frac{1}{2}$ or 4 feet, superfluous limbs removed, and the limbs that are allowed to remain should be cut back about one-half of their length. In Fig. 11 dotted lines represent the approximate points at which cutting should be done on an average 2-year-old tree.

After deciding what limbs are desired to make a symmetrical, well-balanced tree, all others should be removed.

Regardless of whether the tree is 1 or 2 years old, the necessary pruning on the roots is to cut off the ragged ends, thus leaving smooth ends instead of the broken ones left by the tree digger; and if there is a thick mass of fibrous

roots, to cut out some of them.

In the case of trees with very long roots, it is entirely desirable to cut them back so that a hole not more than 12 or 15 inches square will be large enough to set them. There is no apparent advantage in having very long roots on the trees when they are set, and it is much better to have short roots than to have long roots twisted or bent in the setting.



FIG. 10

45. Dipping of Trees.

Some orchardists dip the tops and even sometimes the roots of nursery trees in lime-sulphur solution or miscible oil just before planting. The object of this treatment is to kill all San José scale that may by any chance be present, also woolly aphid or other injurious insects of this class. Experience has shown, however, that it is dangerous to dip the roots in lime-sulphur, and slight injury may sometimes

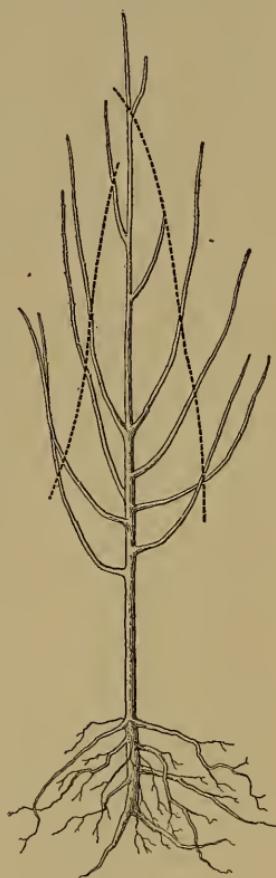


FIG. 11

come from dipping the tops, though dipping the tops down to the roots may be practiced without serious injury if care is exercised. The Geneva, New York, Experiment Station made thorough tests of dipping trees, using standard lime-sulphur, from which it was evident that even wetting the roots with lime-sulphur caused serious injury. Any treatment that causes injury that can be detected on the tree is certainly to be avoided, for slight injury that is not detected may still be enough to weaken the growth of the tree, and if there is any one thing that the orchardist should work for it is a vigorous growth of the tree the first few years. It is safer to use trees that have been inspected by competent inspectors and to avoid the processes like dipping and fumigation as far as possible.

46. Locating Trees in Straight Rows.—The surest method of securing absolutely straight rows in an orchard is to have a surveyor locate every tree, and this is sometimes practiced in sections where the trees are sufficiently long-lived and profitable and where the question of appearance is of sufficient importance to justify such an expensive method. It is likely that in most cases, however, the expense of this method will be prohibitive. One of the most convenient methods of securing straight rows in square planting is to locate the outside rows around the field carefully, probably by the aid of a surveyor if the fences are not known to be on the line or if the lines of the field are not definitely known, and to set a row of stakes with one stake where each tree is to be located in these rows around the field. If the lines of the field are definitely known any intelligent man's judgment will suggest methods of getting these stakes in the right place around the field. Then through the center of the field in each direction, another row of stakes is set as shown in Fig. 12.

With a field laid out in this way, there are always two stakes available in two directions for determining the proper location for each tree in the orchard. For example, the proper location for a tree may be determined by sighting across stakes as indicated by the lines in Fig. 12. The usual method is to set a peg at the point where each tree should go as determined

by sighting; but since the stake must be removed when the hole for the tree is dug a *planting board* is commonly used to

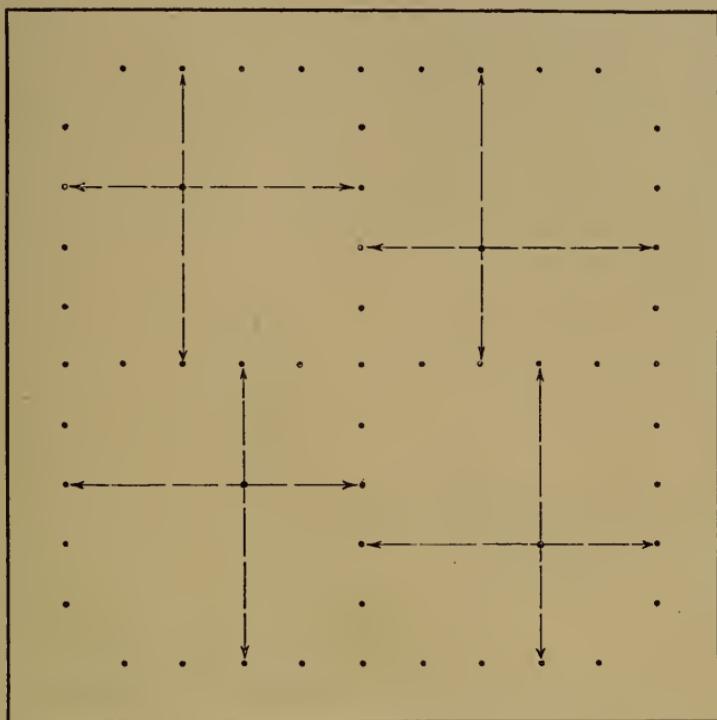


FIG. 12

get each tree in its proper place. In Fig. 13 is shown a planting board by means of which a tree can be planted exactly where the stake originally stood. The notch of the board is fitted

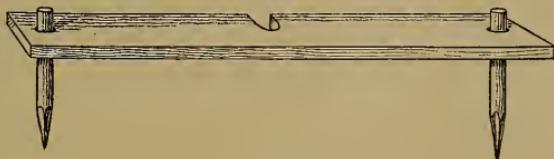


FIG. 13

against the peg that represents the place for the tree and then two pegs are driven into the ground through the holes in the ends of the board. These pegs are left until the hole for the tree is dug, and when the tree is to be set in the hole the board

is again placed on the pegs so that the holes in the ends pass over these pegs. The method of using the planting board is clearly shown in Fig. 14.

47. A cheaper method of laying out an orchard is to use a team and some form of plow, probably a bull tongue in most cases, and mark off the rows in each direction, sighting to the stakes that have been previously set around and across the planting as mentioned. This method is probably as often

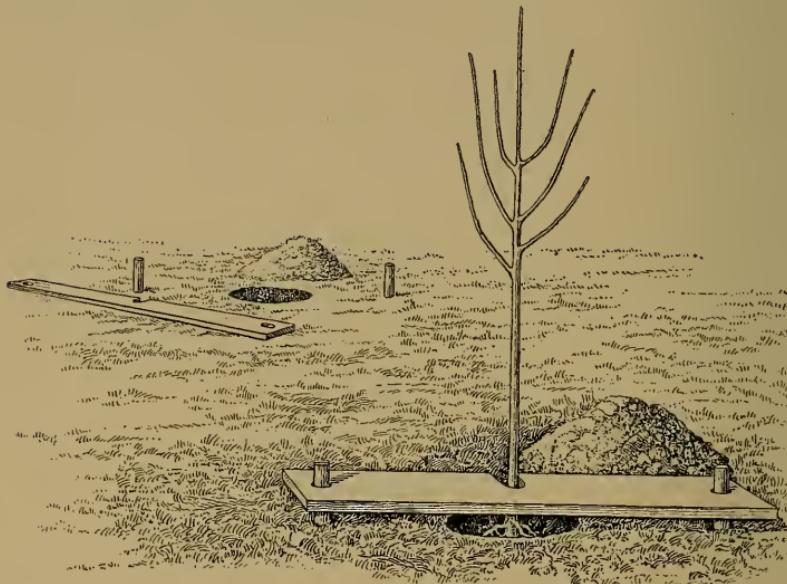


FIG. 14

resorted to as any other. It is also possible to locate the trees without using either the system of marking or the planting board but simply by sighting to stakes in each direction at the time the tree is set. This method, however, is not so accurate as the others, especially if the land is not level.

The field may be laid off with a plow in each direction by using stakes that are set at the time of plowing. That is, say an orchardist is laying off a planting east and west, the first row is carefully located by three or four stakes set east and west. Then, as the man doing the plowing passes the stake, he measures off the proper distance to the next row and sets

the stake over to it. This will give him a line of stakes to come back on in making the next row. It will be best to have an assistant to help set the first end. The rows are located in the other direction in the same way. Although this may not locate the trees with mathematical precision, under most conditions it is accurate enough.

48. In some cases the trees are located by means of a wire such as is used with a check-rower corn planter. A row is first carefully laid out, and each tree in the row located, say east and west at each end of the field; the wire should then be stretched across the field north and south with some sort of markers on it so spaced that each marker will represent the correct position for a tree. The place for each tree may be marked with a stake or a hole may be dug before the wire is moved.

In hilly land it may be difficult to get the trees in straight rows up and down the hill, though this is desirable on account of the appearance. However, in all cases it is advisable to go around the hill rather than over it, and it may be necessary to set the trees in circles around the hill rather than in straight rows across it. In this case the contour of the hill will generally determine the method used for locating the trees.

49. Where trees are set by the hexagonal system, an excellent way to locate the trees and get them in straight rows is to locate the trees in the first row by means of surveying instruments or some other accurate method. Then, with a large triangle of wire, the length of each side of which is the distance apart the trees are desired, the other trees may be located. One point of the triangle is placed at the first tree in the first row and one at the second tree in the same row, making the points come exactly to the tree; then when the triangle is drawn out and held level the other point is at the right position for the first tree of the second row. For locating the second tree, a point of the triangle is placed at the second tree in the first row and a point at the third tree in the same row; then the other point locates the second tree in the second row. This, of course, can be carried on throughout the orchard.

If the orchard is in hilly land, the stakes used for locating the trees should be tall, and the triangle should be held in a horizontal position when locations for trees are being determined.

50. Tools Used in Planting.—The tool most commonly used in planting is a light spade. If the soil is stony, work can be done more rapidly by cutting off the corners of the spade as shown in Fig. 15 (a). In very stony land a mattock or grubbing hoe such as is shown in (b) may perhaps be a better tool to set trees with than a spade.

Some persons advocate blasting the holes for trees. A crowbar or other heavy iron bar is used to make the hole about 3 feet deep and a small charge of dynamite, usually half a stick, is exploded in the hole; then with a spade a hole is dug for the tree. It is claimed that such an explosion tends to break up any layer of hard subsoil that may be in the soil and to favor better growth of the tree roots. A great many orchardists report good results from this method, but it has not been sufficiently tested by accurate experiments to justify positive endorsement of it. There is reason to

believe that in some soils it will give good results, for trees uniformly make a better growth the first and second summers on porous, well-drained soil where the roots can go deep than they do on soils lacking these characteristics. If suitable conditions can be produced by blasting it would seem desirable.

51. Handling of Trees.—At the time of setting it is important to have enough trees on hand to set the entire planting that is staked off, and it is usually desirable to take trees enough to set say four or five rows and heel them in about five

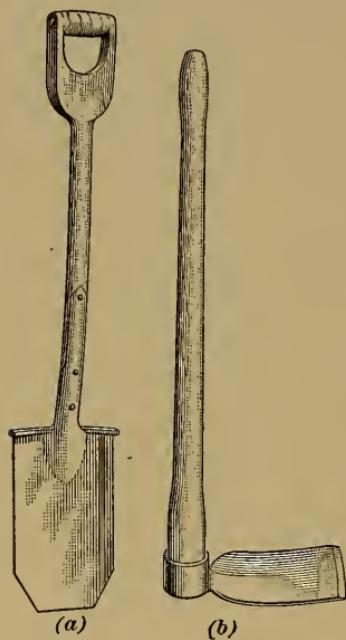


FIG. 15

rows from the first row and carry this on throughout the planting, so that the trees will not have to be carried a long distance during the planting process. In very large plantings it is customary to have the trees in wagons and have the man in the wagon throw them out and a boy carry them to the holes as fast as the men can set them. In no case should the roots of the trees be left exposed to the air until they become dry. It is much better if the roots of the trees at the time of setting are moist enough that the soil will stick to them. If only one man is setting, the roots of not more than ten or twelve trees should be exposed at one time unless weather conditions are very favorable, as when the air is saturated with moisture. All other trees should be carefully heeled-in by the method previously mentioned. Of course, they need not be heeled-in as carefully if they are to be planted within a few hours as if they are to stay several days in the trench. As a rule, water is used around the roots at planting time in only very small plantings. If the soil is in good condition with reference to moisture and the planting is done carefully, the use of water is not generally necessary or even desirable.

In very few cases should trees be set any deeper than they were set in the nursery. In a very porous, warm soil it may be well to set them slightly deeper, but deep setting, especially in a soil that tends to be compact, is likely to break the ends of the roots. Furthermore, when the soil is so cold that new roots start very slowly and the soil is not so well supplied with the necessary elements of plant-food, deep setting is not to be recommended. Some persons practice deep setting to keep the trees from being blown to a leaning position, but this is not to be recommended, for if the top of the tree has been sufficiently pruned and the tree is set firmly it is not likely to be blown to a leaning position. In fact, the tree will probably become braced sooner and firmer if it is set shallow, for under this condition new roots will start more quickly than if planted deep.

In setting trees, it is best to place the part having the most branches to the southwest in sections where there is trouble from sun scald on young trees. This is more likely to give a

shade for the body of the tree against the southwest sun and thus afford some protection against sun scald for the first and second winters.

The usual procedure in setting a tree is to grasp it with one hand and hold it upright in the position it is to occupy permanently, work in some earth with a spade with the other hand until the tree is firm enough to stand erect, and then throw in some loose earth and grasp the tree and pull up on it slightly, pressing the earth very firmly with the feet. In some cases it is best to throw a spade of loose earth over the pressed earth at the top to act as a mulch to retain the moisture. Of course, this process of setting should never be done when the soil is too wet to work if the best results are expected. Especially is this true with clay soil which may become cemented around the tree.

APPLE CULTURE

(PART 2)

MANAGEMENT OF APPLE ORCHARDS

INTRODUCTION

1. Immediately after the establishment of an apple orchard the question of the management of the property comes up for consideration, and the subject is one to which the owner will do well to give his best thought and attention. It is, of course, true that some orchards are failures because of unsuitable location or of improper planting or of choice of unsatisfactory varieties, but, undoubtedly, most orchard failures are due to poor management. In this Section attention is given to the subjects of *tillage*, *pruning*, *thinning*, *fertilization*, and the *renovation of old orchards*. The first four subjects pertain to the yearly routine in all orchards, and much of an orchardist's success depends on his skill in carrying out these operations. The subject of the renovation of old orchards is of importance in this connection, for the reason that many new orchard plantings are put out on farms that already have on them old orchards in a more or less neglected and run-down condition. Apple-orchard management includes also the subjects of spraying, harvesting, marketing, and irrigating. The importance of the subjects of spraying, harvesting, and marketing, however, warrants their consideration in separate Sections, and as the subject of irrigating of apple orchards is not of importance except in certain restricted localities, it also will be considered in a separate Section.

TILLAGE OF APPLE ORCHARDS

TILLAGE OF YOUNG APPLE ORCHARDS

2. Tillage of an orchard during the first year after planting the trees is no doubt more important than in any subsequent year in the history of the orchard. It is of the greatest importance that the trees have a good, healthy start and tillage the first year is favorable to a prompt and vigorous growth of the trees. This fact will be more evident when it is considered that soil is cold in spring and that it slowly warms up to a good depth. Often newly transplanted trees come out in leaf before much growth begins. Not infrequently newly transplanted trees leaf out well, then apparently stand still for a while until the spring or early summer is well advanced. Usually this condition is due to the fact that the beginning of the root growth is retarded by a cold soil. The atmosphere warms up more rapidly than the soil and starts the buds while the roots below are comparatively inactive. Early and frequent cultivation helps to warm the soil to a greater depth and to stimulate root growth. In order to start the growth of the root system when growth of the tree above starts early, spring plowing is desirable.

3. The depth of spring plowing depends largely on the character of the soil. In loose sandy soils, plowing may be shallow. It is never desirable to plow much deeper than the surface soil, for turning up raw unweathered subsoil leaves an unsatisfactory surface for subsequent tillage. Land that has not previously been worked to sufficient depth should not be plowed deep suddenly. It is best to increase the depth of the soil gradually by plowing a little deeper each year.

Care should be taken never to plow deep enough to injure the roots of the young trees. In certain soils and localities, trees root deep and deep plowing may be safe, but in other soils shallow root growth is made and deep plowing is not permissible. In this case it may be advisable to plow the

land deeper midway between the rows beyond the spread of the root system, and more shallow adjacent to the tree row where there is danger of cutting the tree roots.

4. After plowing in spring, shallow tillage should be maintained throughout the growing season. This work should be done with the type of harrow that will best maintain a good dust mulch. A crust should never be allowed to form on the soil. If prolonged rains fall on a moderately heavy soil and weeds get a start it may be necessary to use a disk or cutaway harrow to break the surface. In mellow soils, a spring tooth or an Acme harrow, which merely pulverize the surface, may be adequate.

The time to cease tillage is a question on which opinions differ. Some orchardists advocate ceasing tillage in midsummer in order to give the trees ample time to ripen their wood for winter; others advocate continuing tillage until the close of the summer. No definite date can be given at which tillage should stop, for it varies with the character of the soil, the amount of rainfall during the given season, the rapidity of growth of the trees, and to a marked degree with the character of the winter that prevails in the locality. There is some danger of winter-killing if the trees go into winter in a soft, sappy condition. In Canada and the northern part of the United States, where severe winters prevail, tillage should cease early, perhaps in midsummer, in order to give time for a thorough ripening of the wood before cold weather comes on. In sections where winters are mild or where, with a given variety, winter injury is not usual, tillage may continue to a much later date, perhaps until early autumn. In certain soils, particularly those that are dry, warm, light, and not very fertile, trees tend to ripen their wood earlier than in very rich soils that hold a large quantity of capillary moisture. If in a given season young trees are making an abnormally succulent growth, tillage may be allowed to wane early in the season. In a season when slow, weak growth is being made, or where summer droughts prevail, tillage to save moisture may be continued until early autumn.

TILLAGE OF BEARING APPLE ORCHARDS

5. Most orchardists agree that young trees should have thorough tillage until they reach bearing age, but the question of the tillage of bearing orchards is one on which there is less uniform agreement of opinion. It is doubtless true, however, that the majority of orchardists agree that at least some tillage should be maintained throughout the life of the orchard.

As a rule, bearing apple orchards should be plowed in early spring to warm up the soil and to facilitate the storage of moisture from spring rains in the subsoil below. As in young orchards, the depth of this plowing depends on the character of the soil and the depth of root growth of the trees. Even greater care should be taken not to injure the roots of bearing trees than is needed in the case of young trees. The repair of the injury to a root on a tree of bearing age is relatively slower than in the case of a young tree. Feeding roots of bearing trees become much more numerous and they spread much more uniformly throughout the soil than in the case of young trees. The deeper the plowing, the better, provided it does not go below the top soil or injure the root system of the tree.

6. Shallow surface tillage should be maintained throughout the season by means of harrows or other stirring implements. As a rule, there is less tendency for a soil in similar condition to crust or bake hard under the shade of large trees and there is less tendency for weed growth than in the open sunlight between young trees that do not shade the ground. This, however, should not lead the grower to believe that tillage may be less frequent or may justifiably be neglected in bearing orchards.

7. As trees reach bearing age, the question of what time during the summer to cease tillage probably becomes more important than is the case with trees before they reach bearing age. A young tree is tilled to get strong, vigorous wood growth, and the question of its immediate fruiting demands very little consideration. With the old tree, the grower must take

into consideration not only a maintenance of wood growth but also the inducing of fruit-bud formation. It will be remembered that excessive wood growth opposes the formation of fruit buds, that is, the reproductive process of the tree. If an orchard of bearing age is making such an abundant wood growth that it bears fruit sparingly, tillage should be so adjusted as to check this wood growth to some degree and to favor the setting of fruit buds. Frequently an orchard that is making a rampant growth may be thrown into bearing by ceasing tillage early in the season. On the other hand, if an orchard has fully established the bearing habit and is setting fruit abundantly, thorough tillage should be given in order to enable the tree to carry and mature this fruit crop. In general it may be said that the richer and more drought resistant the soil, the earlier may tillage cease; the poorer or dryer the soil, the later may tillage be kept up.

8. Another important consideration is the dormant or rest period of the tree. In certain sections, fruit trees may be injured by their fruit buds starting into growth in late winter or too early in spring, and as a result of this premature growth being injured by subsequent cold. It is desirable to hold the buds of fruit trees dormant in spring until danger of injury from frost is past. It has been determined that the dormant period of a tree is of fairly uniform duration, consequently it may be said that as a general rule the earlier it becomes dormant in the fall, the earlier will it tend to emerge from the dormant condition in spring; the later it goes into the dormant condition in autumn, the later will it tend to wake from its winter sleep and begin spring growth. For this reason, in sections where trees suffer from the swelling of their buds in late winter, or where they bloom out so early in spring as to be subject to injury from late frosts, it is well to prolong the growing season as late the previous fall as may be done without danger of their growing into winter in an excessively succulent condition.

9. Where severe winter climates prevail, more precautions should be taken for the ripening of the wood in autumn

than in a milder climate, and it is also true that in the severe climates there is less need of prolonging the dormant period, because there is less danger of trees starting growth until settled spring conditions become well established. In mild climates, however, this tendency of fruit buds to swell and grow in late winter or to blossom too early in spring is pronounced, and for this reason it is considered good practice to induce the tree to carry its leaves in the fall until hard frosts actually begin. In such sections there is little danger of forcing the trees into winter in a too succulent condition, hence the grower need not take much thought for the autumn ripening in the wood. In mild climates, a dormant tree is rarely winter-injured, even though it carries its leaves up to the beginning of winter.

CATCH CROPS

10. **Catch crops** are extensively grown in orchards, either for enriching the soil or for the revenue that may be derived from them. Usually they are annual crops such as may be grown and cultivated without interfering with the normal culture that should be given to orchard soil in accordance with the preceding paragraphs, and they are most commonly grown while the trees are young and before they reach bearing age. While the fruit trees are small and do not fully occupy the entire area in the orchard, a part of the space between the rows may often profitably be given to incidental crops that mature in a short period. Furthermore, space between the rows in an orchard is more valuable for the catch crops themselves during the early years than it is later when the trees have become large enough to shade the ground. An orchard is a long-time investment, since it does not begin to yield returns directly until the trees come into good bearing. Often it is very helpful to grow catch crops annually for a time, in order that the land may bring some return before the orchard itself begins to yield fruit.

11. Catch crops may be grown expressly for the revenue they yield, irrespective of their relation to the good of the trees.

It is highly desirable, however, to exclude catch crops of such character as may in any way injure the fruit trees. The desirability of growing catch crops for revenue depends somewhat on a number of factors. One of these is the price of the land. Where land values are high, it is often desirable to produce catch crops that will return an annual income on the investment, but where land values are comparatively low the owner may be able to wait for the orchard to come into bearing without depending on the revenue from catch crops. Another factor is the quality of the soil. If the soil in the orchard is poor and thin and the orchard trees need all the available plant-food in it, catch crops should not be grown unless the plant-food that they remove from the soil can be returned in the form of fertilizer. Where soils are rich, catch crops often may be grown until the orchard reaches bearing age without in any way injuring the future productiveness of the orchard itself. As a rule, better cultivation will be given to an orchard in which some valuable catch crop is being grown between the trees than when no such crop is grown. It is not wise, however, to place too much stress on the annual income from a catch crop if its production opposes in any way the future development of the orchard.

12. Catch crops may contribute directly or indirectly to the fertility of the orchard even on poor soils. If an orchard soil is light, sandy, and low in plant-food but otherwise well adapted to the growing of vegetables or small fruits, the owner may be enabled to put fertilizer on the orchard by using the revenue derived from these crops for the purchase of fertilizers, which he could not afford to apply if there were no immediate income from the orchard land. Under certain circumstances, it is possible to build up the fertility of an orchard soil before the fruit trees come into bearing by the production of catch crops that justify expenditure for fertilization and soil improvement. This is an example of indirect improvement of the soil by growing catch crops. Certain catch crops, particularly the legumes, may be grown so as to enrich the soil in nitrogen and perhaps improve its physical condition

as well. This is direct improvement of the soil by means of catch crops. Any building up of soil made possible by the growing of temporary crops leaves the soil in just that much better condition when the trees come into bearing and call for a large supply of plant-food.

13. Under certain conditions, catch crops may be grown for soil improvement with no idea of adding plant-food to it. For example, in newly cleared lands, if the soil is rich, corn crops are frequently grown between the trees in young orchards to help subdue the stumps of the forest trees and sprouts that spring from them. The corn crop helps to pay for careful cultivation of the land and for the labor involved in cutting out the sprouts and its shade may reduce the vigor of sprouts that do grow. Almost any cultivated crop in a new soil helps to subdue the soil and to bring it to a good state of tilth. It is also true that soils that wash may be held in place by certain types of catch crops.

14. The grains used as catch crops are usually those that pass the winter in the growing state, like winter wheat or rye. A grain crop should rarely, if ever, be allowed to mature its seed in the orchard. Its direct purpose as a crop should be that of winter or spring pasture for small stock such as pigs, lambs, or poultry. It may benefit the orchard land by preventing erosion of the soil, by taking up readily available plant-food that otherwise might wash off in abundant rains or be leached down into the subsoil below, by shading the soil, by preventing the heaving of the soil by frosts, and by adding humus to the soil when the remnants of the crop are plowed under in the spring. Where grains are thus employed, they are usually sown early in the fall to get good growth in order to cover the land well and hold it in place during the winter. They are usually allowed to stand in spring until they have made an abundant leaf growth, and are then turned under to add humus to the soil. Meantime they may have served a valuable purpose as a pasture crop during the fall and early spring. Care should be taken, however, in pasturing orchards during wet times, even with small animals, as the soil may be

badly puddled by their tramping. It should also be further borne in mind that certain animals if pastured in the orchard may injure fruit trees. Goats, mature sheep, and colts often injure the trees if allowed to graze among them. A large number of hogs pastured on a small area may do injury to the tree trunks by constantly rubbing the bark. As a rule, however, the orchard crops mentioned may be grown profitably for pasture, provided care and judgment are used with respect to the character and number of animals pastured.

15. Potatoes are often a profitable catch crop in orchards wherever the soil is suited to their production. The same plowing, handling, and tilling of the soil that the potatoes need is adapted also to the needs of the fruit trees themselves. Potatoes are a low-growing crop and there is less danger of their interfering with the growth of the trees than would be the case with a taller-growing crop like corn, which may shade young fruit trees if planted too close to them. Almost any kind of garden vegetable that admits of good cultivation may be grown in a young orchard provided the soil is rich enough.

16. Melons are often grown with success in young orchards. They draw somewhat heavily on plant-food, however, particularly potash, and for this reason their planting is inadvisable in thin soils unless fertilizer is applied.

The small fruits generally constitute an important catch crop for orchards. Strawberries are low growing and do not compete to an undesirable degree with the fruit trees. Furthermore, as a rule, clean cultivation is given to strawberries through the summer and they are mulched in winter, both of which are favorable to the best development of the orchard. If strawberries are grown, however, plants should be carefully renewed by cultivation between the rows each season. Old, neglected strawberry plantings overgrown with weeds are a menace to an orchard. Blackberries, on account of their rooting habit, loosen orchard soils and frequently leave the land after a few years in better condition for fruit trees than it was before the blackberries were planted. Raspberries may be grown, but they are somewhat objectionable for the reason

that the raspberry is subject to crown gall, which frequently attacks fruit trees. In sections where this disease is common, the planting of raspberries in the orchard is, for that reason, to be avoided.

COVER CROPS

17. Cover crops include, in general, those crops which are grown for the improvement of orchard soil, or for its protection at times. Cover crops are, in the main, distinguished from catch crops in that the latter usually are grown to yield a direct revenue, although, as pointed out in the preceding pages, this is not always the case. Cover crops, on the other hand, are more frequently employed for the benefit of the orchard soil. Catch crops are usually cultivated crops; cover crops are more frequently sowed crops.

Cover crops may be employed to check wood growth of trees and throw them into bearing, to prevent leaching of the soil fertility, to prevent soil washing, to add humus or nitrogen to the soil, or to smother sprouts on newly cleared land. Attention has elsewhere been called to the fact that fruit trees sometimes may run to wood growth rather than to fruit production. Cover crops are sometimes employed in rampant-growing young orchards to check their growth and throw them into bearing. The formation of fruit buds usually begins in the early part of the summer. For that reason cover crops to check wood growth and stimulate the development of fruit buds are usually sown in May or June. Cowpeas are often used as cover crops in the South and field peas or vetches for a similar purpose in the North. All of these are leguminous crops and serve the purpose of adding nitrogen to the soil. On deep, rich porous soils orchards are sometimes even seeded down to clover for a year or two to throw them into bearing. On certain soils this may be done with success. Even grasses are sometimes employed for a season, but the grower should not be deceived into believing that, since a cover crop may throw an orchard into bearing, the orchard should remain under this same cover crop indefinitely. Not infrequently a season's cropping will throw the trees into

bearing and the combined effects of the cover crop and the production of a fruit crop that follows may check the growth of the trees in the orchard. Once a bearing habit is established, it is usually best to resume cultivation and in most cases the trees will no longer run to excessive wood growth.

18. Only a part of the plant-food existing in the soil is ever available or soluble in water at any given time. Additional plant-food, however, is rendered available from year to year. This should be saved in the soil or used for the production of some useful crop; otherwise, it may be carried off largely over the surface by washing rains, or it may leach downwards by the settling of water in the soil, where it will remain out of reach of the roots of the fruit trees. While fruit trees are young and have very limited spread of root system, a bare tilled orchard soil may lose much of its available plant-food. If cover crops are grown they will use this plant-food as it becomes available, and it may be returned to the soil by plowing these crops under or by pasturing them. Furthermore, the addition of organic matter that results from plowing such cover crops under makes the soil more retentive of valuable plant-food, for it forms a sort of a screen in the soil that prevents waste of plant-food by leaching. For this purpose the grower may apply either grain crops as a winter cover or legumes as a summer cover. The same crops that prevent leaching of plant-food may also serve the purpose of preventing erosion of the soil. Soils that wash badly should never be allowed to lie bare, except while cultivation is going on. All cover crops turned under perform the additional office of adding humus to the soil and the leguminous cover crops add nitrogen as well.

19. Time of Sowing Cover Crops.—If a cover crop is being grown for the purpose of throwing an orchard into bearing or for other reasons that permit the use of a full season crop, the time of sowing will be the same as when the crop is grown outside of the orchard. The cases mentioned are, however, exceptional, and, as a rule, it is best to grow such cover crops as will not conflict with the cultivation of the orchard during

the early part of the season. Toward the southern part of the United States, cultivation may continue until the first of July, and there will yet be time to grow a crop of cowpeas, one of the most important cover crops for the Southern States. Vetches, wheat, or rye should be sown early enough in the fall so as to secure a good cover for the ground for winter, or to make sufficient growth to afford good winter pasture, if desired. The farm system employed and the use to which cover crops are to be put will help to determine the time of planting each. For example, one successful orchardist uses rye in a part of his orchard for autumn, winter, and early spring pasture for young hogs. This is followed by oats in another portion, or by rape, which is not pastured until June. Cowpeas are then put in late in June or early July to furnish late summer and early autumn pasture. In this way all the land in the orchard is gotten over on rotation, with cover crops arranged to form the best possible succession of feed for hog pasture. With such a judicious plan of rotation cover crops may serve a very valuable purpose on the farm outside of their relation to the orchard soil itself.

20. Time to Plow Cover Crops Under.—As a rule, cover crops should lie on the ground through the winter and be plowed under when cultivation begins in spring. Even the legumes will lose very little of their plant-food if allowed thus to lie on the soil, and any loss by decomposition of the plants will be more than compensated for by the shade and cover afforded to the soil. If green cover crops are used, they should be plowed under at least before they go to seed and before the spring weather is very far advanced. It is unwise to allow a cover crop to lie in an orchard until summer and then suddenly plow the crop under and begin tillage. Such a procedure is likely to induce late growth in the trees. Furthermore, any root pruning that results from the plowing may be very injurious to the trees in midsummer; although they may not be injured at all by a similar root pruning in early spring while dormant. Cutting off roots in midsummer when the trees are in full leaf and hence are calling for a maximum supply

of water may have the same effect as severe drought, but root pruning by plowing in spring when the tree is dormant, if judicious, may not prove injurious in any way. As a rule, it is not wise to plow orchards in autumn in sections where deep freezing of the soil prevails. Toward the south, however, autumn or even winter plowing may be carried on successfully whenever the soil is in condition to be worked. For this reason, spring turning under of cover crops is advised for the North, but they may, in regions of mild winter, be plowed under in the fall or even in winter, if necessary.

21. Leguminous Cover Crops.—The clovers, cowpeas, field peas, soybeans, garden beans, and the vetches are satisfactory cover crops in sections that are adapted to their culture, and since they are leguminous plants they have the additional advantage of adding nitrogen to the soil. If the entire crop produced is turned under or is pastured on the ground to pigs before turning under, a much larger supply of nitrogen will be added to the soil than the plants take from it. If these crops are grown, harvested, and removed from the soil, their roots and stubble may not return as much nitrogen as was drawn from the soil in their production, but these legumes have, nevertheless, the effect of mellowing and flocculating the soil. They root deeply and leave the soil in most excellent condition for subsequent tillage. For improving either the fertility or the structure of the soil they are regarded as the most valuable cover crops for orchards. Which to choose depends largely on the location, type of soil, and also the purpose to which the crop may be put, that is, whether it is to be harvested or pastured. In the southern part of the United States the cowpea is the one great orchard cover crop, but in the northern part where the climatic conditions are not suitable for growing cowpeas, field peas are extensively grown. Either of these crops furnishes excellent pasturage for small stock, and usually it is more profitable to pasture them and then turn the stubble under than it is to turn the entire crop under. If pastured, a large part of the crop is returned to the soil in the form of manure. In the South the

soybean is a more abundant seed producer than the cowpea, and where feed for hogs or for poultry is desired, the soybean, perhaps, comes nearer to meeting the requirement than the cowpea. Any of the legumes mentioned are suitable for hay, and where it is desirable to get a hay crop from the orchard soil, any of them may be grown for this purpose, although clovers and cowpea usually produce better hay crops than the others. The common white bean, or navy bean, although sometimes cultivated in orchards, is probably the least valuable to the orchard of any of the legumes mentioned, although it undoubtedly adds more nitrogen to the soil than is removed from it by the crop unless the entire plant is harvested. The farmer considers it harder on the soil than the other legumes, but in some districts, especially in the North, the bean is a very profitable farm crop and may consequently pay for applying fertilizer or organic matter to the orchard.

22. Non-Leguminous Cover Crops.—Among the non-leguminous cover crops that are sometimes used for orchards, buckwheat, rye, winter wheat, and barley are probably most commonly used. Some orchardists have used oats, but the best authorities regard them as objectionable on account of the fact that they are said to be heavy feeders and hence take large quantities of plant-food from the soil, and furthermore they use large quantities of water and consequently are likely to leave the soil too dry for the trees.

SOD CULTURE

23. Sod Culture is a term adopted in somewhat recent years, and signifies that the soil in the orchard is not cultivated but is permanently seeded to grass, clover, or other sod crops that will maintain themselves and that the growth produced remains to die down on the ground or is cut and allowed to lie, thus forming a mulch. It should be distinguished from simply maintaining the orchard in grass that is to be mowed for hay or pastured to stock, by the fact that

under the former system whatever the sod crop produces in the way of new growth each year is allowed to remain on the orchard soil to make an ever-increasing mulch and to add humus to the soil. On certain soils and in certain localities, orchards have proved profitable when handled in this manner.

24. Advantages of Sod Culture.—Some of the objects sought in sod culture are: to prevent erosion of the soil, especially on steep slopes; to avoid the labor and expense of soil tillage; to avoid the danger of injury to the roots by plowing and tillage in soils where the trees root very near the surface; to retain soluble plant-food near the surface in soils that leach badly; and to maintain a cool cover in soils that dry out or heat up badly during summer.

It is probable that the most important reason for sod culture is to hold the soil in place on slopes so steep that even temporary tillage cannot well be given without excessive erosion. Many steep hillsides may profitably be planted to orchards and maintained in sod culture where the soil could not be held in place if even brief early spring tillage were practiced annually and followed with cover crops later in the season. Even granting all the advantages of tillage in an orchard alternated with the growth of cover crops, it is in many cases better to maintain the orchard in permanent sod and hold the permanent surface soil in place than to till and allow the soil to slip away into the valleys and streams below. Again, there are certain soils that have such a tendency to wash when cultivated that it is difficult to hold them in place even when the slope is not great. This is particularly true of soils largely made of excessively fine particles. It is also true of a soil that heaves badly and slides during alternate thawing and freezing in winter. Some soils, if bare, also run together, crust over, and bake badly in a dry time. Good tillage is difficult under these conditions, and a good dust mulch can hardly be retained in place. Where either of these conditions prevail, sod culture may be justifiable.

In certain fine, light, sandy soils the sand can be held in place only by retaining an abundance of plant fiber in the soil

or by maintaining a sod mulch. In such soils, as soon as tillage has been maintained for a few years, the sand will begin to drift, moving about so that it is impossible to hold the soil in place about the roots of the trees. If such soils are long kept bare, it becomes impossible to get a stand of cover crops due to the sifting of the sandy surface soil. Often, in such a locality, the only practical way of holding the soil in place is by the means of permanent sod.

Undoubtedly there are conditions under which sod culture may succeed better than methods of tillage. Wherever sod culture is maintained, however, the fact cannot be too strongly emphasized that sufficient growth should be secured to maintain a thick mulch in connection with the sod. The term sod culture seems to be contradictory, since the maintenance of a sod does not admit of tillage, which is usually implied by the term culture, but it should be remembered that under a sod, where the grasses or other plants forming it fall down and die on the ground annually, any soil will take on a mellow and flocculent condition. This condition becomes closely akin to the mechanical or physical condition of the soil brought about by good tillage. There are undoubtedly certain soils that will, under tillage and burning out of the humus, become more compact, run together, bake worse, and suffer more from drought than they will under what is termed sod culture.

25. Disadvantages of Sod Culture.—It should be understood that there are certain fundamental disadvantages in sod culture, one of which is that the grass or other plants forming the sod take from the soil moisture and plant-food that is needed by the trees. It is believed by some that grasses or sod-forming plants not only compete with the roots of the trees but that they have a more or less injurious effect on soil that is being utilized for orchard purposes and hence are prejudicial to the best health of orchard trees. It is not definitely known to just what degree sod plants may be injurious or interfere with the growth of orchard trees, but there seems to be reason to believe that some such action takes place. Another objection to sod culture is that many insects multiply

much more abundantly in orchards under cover of permanent sod than in cultivated ground. This is particularly true of the curculio. Many species of noxious orchard insects hibernate in the soil and may be smothered or destroyed by stirring the soil at the right time of year, but this method of insect fighting is not feasible in an orchard that is under sod culture. It is also true that fungous diseases that develop in decayed leaves or fruit and other trash under the trees will develop much more abundantly where sod is maintained than where surface tillage and a dry dust mulch prevail.

MULCH CULTURE

26. The method of orchard management known as **mulch culture** consists in applying to the ground a mulch of materials grown elsewhere, whereas in the sod-culture method just described the mulch material is grown in the orchard. Straw, strawy manure, weeds from the fence rows or roadways, leaves, corn stalks, or any organic material grown on other lands may be hauled into the orchard and used as a mulch about the trees.

Most of the reasons mentioned for sod culture, the conditions under which it may be maintained, and the general merits and demerits will apply with equal force to mulch culture. Although it is true that, as a rule, mulch culture is too expensive for large orchard areas, there is an important point in mulch culture that should be emphasized. It usually should be the beginning of sod culture, in order to hasten the formation of a mulch, because 1 or 2 years are required to establish a mulch by sod culture. Consequently the soil dries out, cracks in a dry time, and the orchard trees are likely to suffer from drought. The strongest advocates of sod culture usually emphasize the desirability of placing all possible additional mulch under the trees in the orchard during the first year or two, while the sod mulch is establishing itself.

After seeding an orchard for sod culture in the spring, grasses are allowed to grow and are mowed frequently during the season—perhaps three or four times in the season. In addition, on the appearance of dry weather in late summer,

any available straw or other mulch that can be had should be spread under the trees. If at any subsequent time the sod does not make cover enough to protect the ground against baking, drying out, and cracking open, additional mulch should be hauled in. If the trees are young and consequently feeding in restricted areas, this mulch should be spread under the trees as far as their outspread of branches, but if the trees are large the mulch is usually distributed evenly between the rows.

Mulch culture has an advantage over sod culture in the fact that a mulch drawn into the orchard may be applied to any depth necessary to protect the soil from drying out or baking and it may be increased at any time. The tendency in sod culture is to depend on the sod to form at least the main part of the mulch. Mulch culture, however, has the disadvantage of being far more expensive, as it is obviously cheaper to produce the mulch on the orchard area itself than to devote other land to mulch production and haul the mulch to the orchard.

PRUNING OF APPLE TREES

OBJECTS OF PRUNING

27. Pruning consists in the removal of superfluous or undesirable branches from trees or plants and is one of the important details of apple-orchard management. Notwithstanding the importance of pruning, there is a wide difference of opinion among orchardists as to the details of the operation, and it must be admitted that the subject is one that is not well understood.

28. Pruning to Reduce Leaf Surface.—It has been explained elsewhere that it is necessary to reduce the leaf surface at the time of setting, since the roots have been cut and thus the ability of the tree to secure water from the soil has been reduced. If a full leaf surface is left, there is danger that the evaporation may be so great as to weaken materially the tree or even cause its death during a dry summer. Pruning to reduce the leaf surface may also be necessary in the

case of old trees whose tops have become very large, in the case of weak trees, in the case of trees growing in a soil where the roots are not able to penetrate deeply, and in the case of trees whose wood has been badly injured in winter.

29. Pruning to Control Shape.—It is only by pruning that the desired shape of a tree can be maintained. The natural growth of the tree is not likely to be along lines desired by the orchardist, hence it is necessary to resort to artificial means of controlling the shape. As explained in detail on subsequent pages, it is by judicious pruning that the orchardist makes his trees high-headed or low-headed and establishes a pyramidal or an open-headed form as desired. Some varieties lend themselves to one of these forms better than others, but pruning to maintain the form is necessary in all cases.

Pruning is also necessary to prevent the trees from becoming too tall in some cases and too straggling in others. The growth of the trees may be made more stocky by pruning, especially if considerable cutting back is done, and this is essential in the case of most varieties to give the desired form of head and strength of limb.

30. Pruning to Regulate Vigor of Growth.—The vigor of growth of a tree can be very largely regulated by pruning. Pruning, especially in winter, tends to invigorate the tree by inducing a heavy growth of wood during succeeding seasons. After pruning, growth will continue later in the summer and the new twigs will be larger and stronger than if left unpruned. On the other hand, summer pruning may be done at a time that it will reduce the vigor of the tree, and in a few cases this also may be necessary.

31. Pruning to Control Size.—The size of a tree can be very materially affected by pruning. It has been established by the experience of many practical growers and experimenters, especially that of Professor Pickering, of the Woburn Experiment Station, England, that pruning is a dwarfing process. Although a tree, after a severe pruning in winter, will make more vigorous growth the summer following, it will

seldom make sufficient growth to replace what was cut off plus what growth would have taken place if no pruning had been done. After 20 years of rather severe pruning, trees will, as a rule, be considerably smaller in most soils and climates than if no pruning had been done. There are exceptions to this, however, in the case of thin soil in climates in the southern part of the apple-growing region. Thus in the Ozark region, cases have been observed in which pruning had the opposite effect; that is, it increased the size of the tree. There were cases in which the soil was poor and the climate not well adapted to the apple, and as a result the trees became bark bound. Severe pruning overcame this condition and permitted the trees to make a more vigorous growth than would otherwise have been possible. It has been found that pruning in summer has more of a dwarfing effect than pruning in winter.

TIME OF PRUNING

32. The time of pruning will depend on the condition of the tree and the extent of pruning to be done. If it is merely necessary to cut out a few crossed limbs or to remove a few limbs that are filling up the center of the head in an undesirable manner, the pruning may be done at any time that is most convenient; but if considerable wood is to be cut off, it is advisable to give the matter of doing it at the proper time careful consideration.

Generally speaking, it may be said that winter pruning is most desirable, for pruning at this time tends to invigorate the tree. However, if a tree is making too rapid growth and is not fruiting well, it may be advisable to prune in summer, though probably the safer plan would be to resort to some other method to check growth and induce fruiting. Summer pruning is supposed to encourage fruitfulness, and growers have at times successfully resorted to summer pruning as a means of throwing unproductive trees into bearing. But it should be pointed out that this method is not uniformly successful and is hardly to be generally recommended. To induce fruitfulness, summer pruning must be done shortly

after length growth of wood ceases in the summer. Pruning earlier than this will have a very similar effect to winter pruning, and will not increase fruitfulness, and pruning later will tend to check the formation of fruit buds and to produce a rather undesirable growth. Furthermore, it may be said that even pruning at the proper time does not always produce fruitfulness on an over vigorous tree, and it is generally much safer to plant the too vigorous growing varieties on thin soil and thus check their growth and encourage fruitfulness than to plant them on rich soil and depend on summer pruning to throw them into bearing.

TYPES OF HEADS

33. For the purpose of this discussion, a fruit tree may be regarded as made up of two parts, namely, the **trunk**, which consists of the lower part of the main stem extending from the ground to the point where the first branches are thrown off; and the **head**, which comprises the part of the tree above this point. Orchardists recognize several distinct types of heads, and a man who is establishing an orchard should have a knowledge of the different types, the advantages and disadvantages of each, and an understanding of the pruning by which he may induce the formation of type desired. Apple trees may be pruned a *high-headed* or a *low-headed* type.

34. When a tree has been so trained as to develop its head comparatively high from the ground, as shown in Fig. 1, the tree is said to be **high-headed**, and when it has been so trained as to develop its head relatively close to the ground, as shown in Fig. 2, it is said to be **low-headed**.

Owing to the fact that somewhat different methods are followed in the various apple-growing sections, it is difficult to say just what constitutes the dividing line between high-headed and low-headed trees. A tree in one section may be considered to be low headed and in another, where methods are somewhat different, to be high-headed. In general it may be said, however, that trees headed higher than from 36 to 40 inches are high-headed trees, and probably most

advocates of low-headed trees will prefer to head their trees from 18 to 30 inches from the ground.

Where the soil is rich and the trees are to be permitted to get very large, high-headed trees may be necessary, in order to enable a team to get reasonably close to them in cultivating. High-headed trees may be necessary, also, in case of very vigorous-growing varieties like the Northern Spy, since pruning



FIG. 1

to keep down the size of these may result in too vigorous wood growth at the expense of fruit growth. The high-headed tree was more common in early fruit-growing days before spraying was necessary than it is now. Progressive orchardists object to it for the reason that the spraying of high-headed trees is slow, expensive, and unsatisfactory, and picking the fruit, pruning, keeping out canker, and other details of care are also expensive and not likely to be done effectively in the

case of a high-headed tree. In nearly all sections growers are coming to prefer trees with low heads, even with the vigorous growing varieties, and by enriching the soil, seeding down to grass and pruning heavily are usually able to get as good

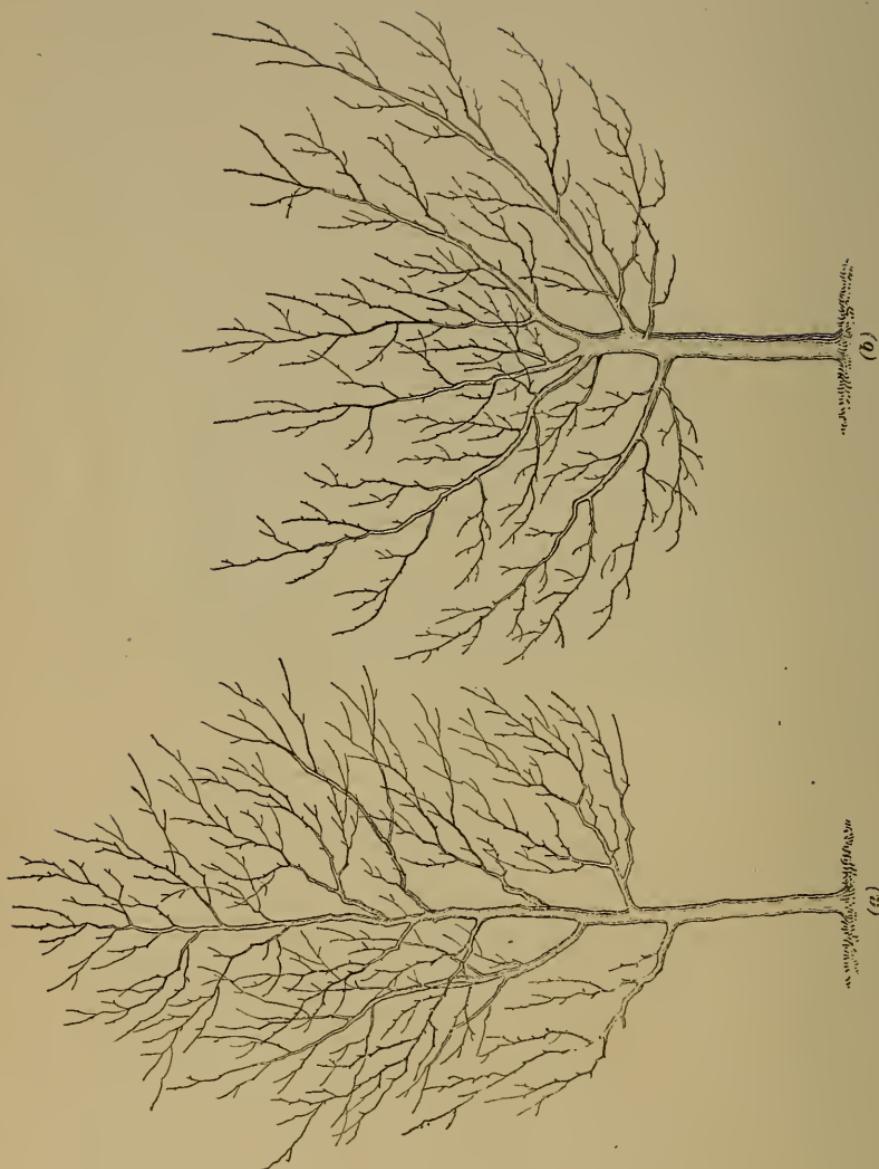


FIG. 2

results with smaller trees and possibly a somewhat larger number of them per acre.

35. Of the low-headed trees there are two forms, the **pyramidal-headed**, in which the tree has a central leader as shown in Fig. 3 (a), and the **open-headed**, as shown in (b). In the pyramidal form, as will be seen in the illustration, the main stem, or trunk, extends to the top of the tree and side branches thrown off from it make up the head. In a tree of the open-headed form the head is formed from four or five

FIG. 3



of the lower side branches, the main stem being cut off above the uppermost branch.

The advantages claimed for the pyramidal-headed tree with a central leader over the open-headed tree are: (1) the limbs are smaller in proportion to the body of the tree and are, therefore, less liable to split down when they break off; (2) if one is broken off, it is only a small part of the tree and there is therefore less injury than would be the case if a limb of an open-headed tree were broken off; (3) the limbs are also shorter and not so badly bent under a load of fruit; (4) the body of the tree and main limbs are in a measure protected from the direct rays of the sun and thus not so likely to suffer from sun scald in winter; (5) if the tree is neglected for a year or two, smaller injury results than with the open-headed tree.

There are some distinct disadvantages, however, with this form of head. These are: (1) it is very difficult to maintain the central leader after the tree gets old, and forks in the top of a fairly tall tree are expensive to correct; (2) too much of the fruit is borne in the shade and the color is not so good as in the case of the open-headed tree; (3) probably the most serious objection is that, on account of the shade, the fruiting wood is kept largely on the periphery, so that no considerable shortening can be done without greatly reducing the number of fruit buds for the crop following the pruning, since the wood that is taken off in shortening the branches is the wood that bears the fruit buds.

36. The advantages claimed for the open-headed tree over the pyramidal form are: (1) fewer limbs are used and those left are maintained in a healthier condition, because they have room to develop; (2) the tree is more open to admit sunlight and the wood is, therefore, healthier, and the fruit is better colored and better developed; (3) the pruning and spraying, especially the latter, and the picking of the fruit can be done more cheaply and more thoroughly; (4) the trees can be cut back to the desired extent each year without danger of too greatly reducing the number of fruit buds, because the fruiting wood is kept further down the limbs, which favors

healthy growth to the very base of the limbs in some cases; (5) the fruit borne does not exert a great strain on the limbs, because, instead of being borne entirely at the end where there is the greater leverage, it is distributed throughout the length of the limb; and (6) experience shows that fruit on the open-headed tree is more uniformly large than on a tree of the other type. This is probably on account of its being distributed along the limb instead of clustered at the end, as is likely to be the case in pyramidal-headed trees.

The disadvantages of the open-headed tree are: (1) the small number of limbs, usually not more than four, and as these must be large there may be danger of the limbs splitting down; (2) the limbs are likely to be longer, because the tree tends to spread out rather than grow up and this takes up more space. These disadvantages, however, are offset by clipping the trees annually and thus making them stocky so they will stand up well under a load. They are also offset to some extent by directing the growth of the main limbs upwards so that they will stand up under the load better and by furnishing artificial support for the limbs when they are heavily laden with fruit.

ESTABLISHMENT OF THE FRAMEWORK

37. Three or four years will be required for establishing the framework of either the pyramidal-headed or the open-headed tree, and in doing this certain precautions should be observed. For instance, weak crotches and bad forks should be avoided, and two limbs should not be allowed to come out directly opposite each other on the trunk of a tree; the limbs should be spaced 6 or 8 inches apart along the trunk, and two limbs should not come near each other on the same side of the tree. In establishing the framework of the open-headed tree, only about four or five main branches should be allowed to develop; for the pyramidal-headed tree, from seven to ten main branches may be developed, and these should be well spaced around the central leader.

PRUNING FOR PYRAMIDAL HEAD

38. A common mistake in starting a pyramidal-headed tree is to allow the limbs to come out too near each other, as shown in Fig. 4 (a). This error results from the fact that when the trees are small the limbs do not appear to be crowded, but when such trees approach maturity it will be found that the limbs are close together and growth cannot take place near the base. A more desirable spacing of limbs is illustrated in (b) where no two limbs are directly opposite each other.

The pruning of a 2-year-old nursery tree for the pyramidal head must be done with a view of giving the central leader the advantage, of preventing the formation of weak forks, and of forcing the growth into the slow growing limbs by clipping back the rapidly growing limbs. The high limbs on the main leader will, as a rule, grow more rapidly than the lower ones, and these, therefore, are usually cut back more severely than the lower ones.

39. During the first summer the buds that come out where no limbs are desired should be rubbed off, and the winter after the first summer's growth the new growth on each of the desired limbs should be cut back approximately one-half, though on the upper limbs it will probably be necessary to cut back more than one-half, and possibly the lower limbs should be cut back a little less than one-half. This same winter it may be necessary to cut off some

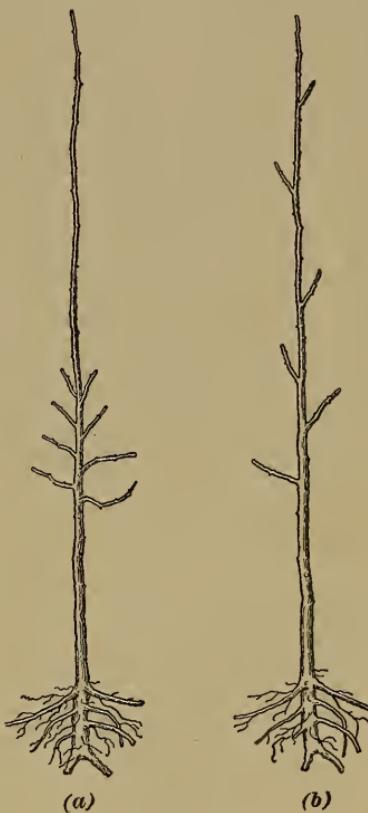


FIG. 4

of the twigs from the main limbs that are left, since it is important that the secondary branches, also, will be well spaced and stocky.

40. During the second winter it will again be necessary to cut back the main branches and the leader in about the same manner as suggested for the first winter. If the leader



FIG. 5

is not growing rapidly enough it will, in all cases, be necessary to cut back the main branches more than was suggested, in order to force the growth into the leader.

41. The general extent of the pruning that should be done to a tree in its third year is illustrated in Fig. 5, which shows in (a) a tree before it has been cut back and in (b) the tree

after it has been cut back. During the next few years, the necessary pruning is to keep the secondary branches—that is, the branches springing from the main branches—and the branches springing from the secondary branches well spaced in order to permit light to reach all parts of the tree; it is also important to cut out limbs that tend to cross and those that are badly injured, and to prevent forks by cutting back limbs that are growing rapidly and giving indications of becoming too large.

42. As a general rule the trees should not be permitted to get any taller than they are at the age of about 8 or 9 years; after this age the center of the top should be cut back to about the same point each year, otherwise pruning of the tree will become very expensive in later years, on account of the extreme height of the top. The method recommended is only a modified form of the real central-leader tree, for a central leader, if maintained throughout the life of the tree and permitted to become taller each year, develops into an extremely undesirable form, and spraying, pruning, harvesting, etc., become uneconomical and difficult or impossible.

PRUNING FOR OPEN HEAD

43. In pruning to form an open-headed tree, the grower should have in mind a definite ideal and work toward it. The best results can be secured by beginning with large 1-year-old trees, such as the one illustrated in Fig 6, (a), for in this case buds can be permitted to grow where limbs are desired and all others removed when they start growth. If it is necessary to start with 2-year-old trees, it may be advisable to cut off all existing branches, select about four buds that will produce branches at desired points, and allow these to grow. Occasionally, a 2-year-old tree may be found that has four good, stocky branches properly spaced for the development of the desired form of head and in such cases these branches may be allowed to remain and all others removed; the branches selected for the formation of the tree should be from 4 to 6 inches apart

and be evenly spaced around the trunk. Unless such limbs are to be found on a young tree it will be best to remove all limbs as directed and permit new ones to start at desired points. Stockiness is of even more importance in establishing an open-headed tree than one with a pyramidal head, and this stockiness is secured by clipping the limbs back.

44. Pruning the first winter should be to cut back each of the four branches one-half and cut the central, or main, stem back just about even with the top branch so that it will

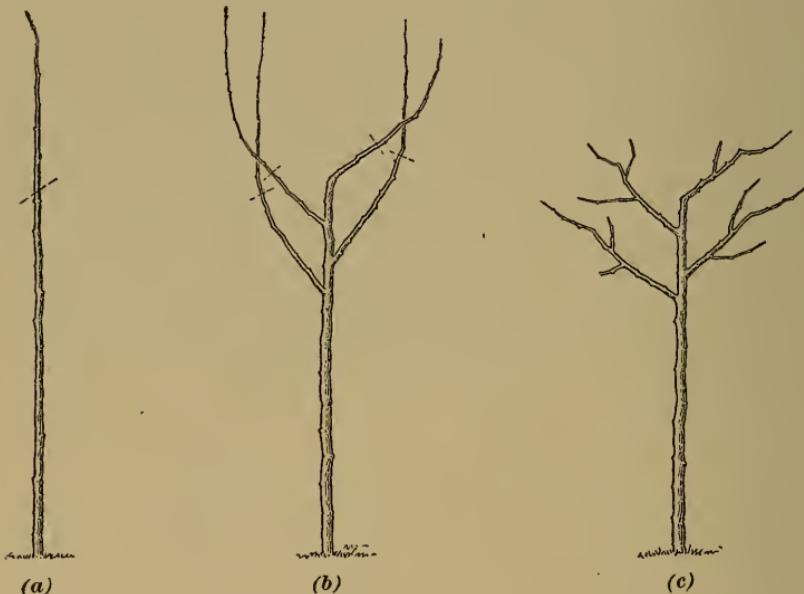


FIG. 6

heal over. During the second summer it may be necessary to rub off sprouts that tend to push up into the center, and thus throw the growth into those limbs that it is desired to retain. The pruning in the second winter should be directed toward cutting back both the main and the secondary branches about one-half and keeping the secondary branches well spaced on the main branches, by cutting off all superfluous secondary branches. These branches should be at least 6 inches apart on the main branches. The points for cutting back the main branches are indicated by dotted lines in Fig. 6 (b).

45. Pruning similar to that recommended for the first and second years may be necessary in the third summer; the third winter the pruning should be to space the third-year branches on the secondary branches and to cut back all new growth about one-half for the purpose of securing stockiness. A 3-year-old tree properly pruned is shown in Fig. 6 (c).

46. The spacing of the limbs and cutting back of the twigs should be carried on in later years, but the cutting back should be less severe up to the time the tree reaches bearing age unless the tree tends to be slender, in which case the cutting back should be somewhat more severe in order to promote stockiness. If the tree tends to spread too much, the ends of the branches may be cut back to an upright limb, thus forcing the growth upwards.

47. Water sprouts may give somewhat more trouble in the case of the open-headed than in the case of the pyramidal-headed tree; undesirable water sprouts should be rubbed off during the first winter, so that the growth will go into desirable limbs. Occasionally a water sprout may come at a place where a limb is desired, and in this case it may be made into a desirable branch by cutting it back about one-half, and following this the next year by cutting back each of its branches about one-half.

PRUNING OF BEARING APPLE TREES

48. The pruning of a pyramidal-headed apple tree should be to cut out crossed or injured limbs, to shorten those that are growing too long, and to cut down the central leader in order to prevent the tree from becoming too tall. Some annual clipping, also, is necessary in order to help keep up the vigor of the tree.

Annual clipping of an open-headed bearing tree is of more importance than in the case of the pyramidal-headed tree, since it is necessary both to keep up the vigor of the tree and to keep the limbs stocky and strong. It may be necessary to cut out growth that takes place in the center of an open-headed tree and tends to fill up the space in the head, or it

may be necessary to cut off the outer limbs and push the growth into upward-growing branches in order to prevent the tree from becoming too spreading in form.

Fruit growers do not usually recognize the importance of pruning to regulate fruitfulness. If a tree receives little or no pruning, and especially if it is not well cultivated, after it becomes old each spur will bear a fruit bud on its end. Usually a spur that bears a flower cluster one year will be barren the year following. The result will be that the tree will bear an excessively heavy bloom one year and no bloom the next; that is, the tree will alternate a heavy crop with no crop. With somewhat heavy pruning, and especially if this pruning is associated with good cultivation, a considerable percentage of the spurs in any one year will not have fruit buds, and thus will be left to set fruit buds for the year following. In other words, a medium number of fruit buds will set each year instead of a very large number on alternate years. Thus pruning and cultivating to give the trees greater vigor of growth will prevent alternating with most varieties. However, with some varieties alternating is a very fixed habit that apparently cannot be broken entirely by any known method of care. While a tree kept in vigorous condition by good pruning and cultivation will have a lighter bloom each year than it would have on the cropping year where it is left to make a weak growth and alternate, it does not necessarily follow that the crop of fruit will be lighter. In fact, the crop of fruit ripened is very likely to be almost as large each year as the crop ripened on the alternate years with a weak tree. This is true because the fruit is likely to be larger and also because the bloom is healthier and more likely to set fruit than that on the weaker alternating tree. It has been found that a large percentage of the pollen on old neglected trees is sterile, so that there is often liable to be a light set of fruit from a very heavy bloom.

Pruning of bearing trees will also be necessary at times to control certain diseases like blight and canker. Badly blighted and cankered areas should be cut out and all forms of diseased limbs cut off and the wounds painted.

DETAILS OF PRUNING

49. An important detail to be observed in pruning, particularly in the case of large trees, is to leave wounds that will heal readily. One of the most common errors in this respect is that of cutting off limbs at such a distance from the trunk or parent branch as to leave stubs varying from a few inches to a foot or more in length. These stubs are not only unsightly and inconvenient in thinning and spraying operations, but they are also a source of serious injury to the tree itself. By the removal of the outer end of the limb the stubs have been deprived of nourishment, and as a result the bark on the stub dies and falls away. The exposed wood decays, and

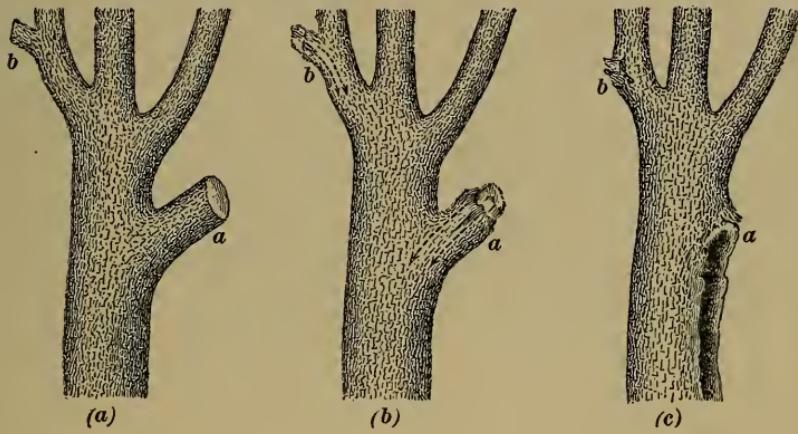


FIG. 7

ultimately the decayed area extends into the trunk or the larger branch from which the stub protrudes. In this condition the wound is difficult to treat, and if untreated is likely to destroy the tree sooner or later.

In Fig. 7 (a), is illustrated a tree pruned in such a way as to leave a stub *a* on the trunk and a stub *b* on a limb. In (b) is shown the manner in which these stubs begin to decay, the dotted lines indicating how the decay will ultimately extend into the adjacent wood. In (c) is shown the ultimate result of this neglect. If instead of leaving stubs as shown in Fig. 7, the limbs are removed by making the cut close to the trunk,

the trouble just described will be avoided, for in this case the tree is able to cover the wound with new tissue that protects it from organisms that cause decay. The plant-food necessary for this new growth is available at this point, for there is leaf surface just beyond to supply it. For the reason just explained, it is usually advisable to cut off the limbs as close to the trunk or the parent branch as possible, although this is not always the case. Frequently there is more or less of an enlargement at the base of a limb. In such cases, cutting the limb at the point where it joins the trunk will result in a much larger wound than if it were cut about half way through the

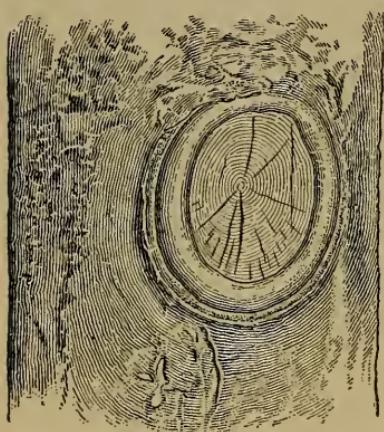


FIG. 8

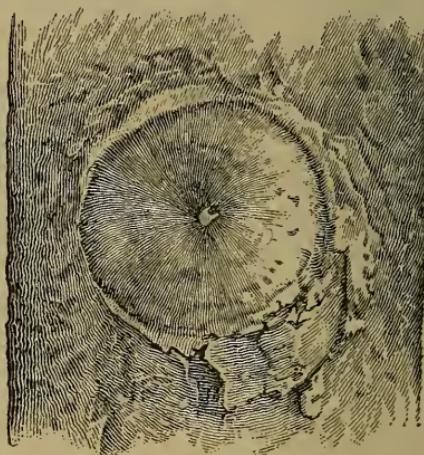


FIG. 9

enlargement and the smaller wound will heal more quickly even though it is a little further from the trunk than the larger wound.

Figs. 8 and 9 give a good idea of the healing process that takes place over a properly made wound. Fig. 8 shows callous tissue just beginning to cover a wound, and Fig. 9 shows the wound almost covered with new growth.

50. As a safeguard against the entrance of organisms causing decay, all wounds except possibly very small ones should be painted with either common white-lead paint or with grafting wax, and if the wound is very large it should be painted every season until it is healed over.

When a limb is to be shortened it is always advisable to cut it at a point where there is a strong branch thrown out from it. Care should be taken to avoid splitting a large limb that is being cut back, because such a split is likely to extend down and injure wood it is desired to retain. A method by which splitting may be prevented is to saw in about an inch or more on the under side of the limb, then to saw the limb off from the upper side about an inch below where the cut was made on the lower side. The limb will thus be sawed off before the lower side of it becomes so weak that it will split down. Very large limbs should be first cut off a foot or more beyond where they are ultimately to be cut, thus reducing the danger of a serious split by removing a large part of the weight before the final cut is made.

THINNING OF APPLES

51. Successful apple orchardists have found that it is not, as a rule, advisable to permit trees to mature all the fruit they set. The practice of removing by hand a part of the fruit before maturity is known as **thinning**, and is now an established routine in most apple orchards.

By removing some apples from a tree the fruit that remains develops to a larger size, better form, and acquires a better color than would have been possible if thinning had not been done. Thinning is commonly recommended not only for the improved quality of the current season's crop but to improve the chances for the crop the following season; that is, to prevent alternate seasons of good and poor crops. The theory is that the spurs from which the fruit is pulled in thinning will set fruit buds for the following season, and the spurs on which the fruit is allowed to remain and mature will form only wood buds. Experience, however, so far does not fully bear out this theory for in the case of an experiment at Geneva, New York, thinning failed entirely to affect alternating. In other experiments, it seems to have some slight effect, and it is possible that if thinning is practiced from year to year, the trees may be kept from the habit of alternating, but it is not likely

that thinning will break the habit of alternating in a tree after it is once fixed. Most orchardists are agreed that an effective way to prevent alternating is by careful annual pruning and cultivation, and that thinning associated with these processes may be beneficial, but that thinning alone cannot be depended on to prevent alternating.

It pays best to thin in sections where the growers are cooperating so that the increased number of fancy apples can be handled to a good advantage, for thinning is favorable to the production of fancy fruit. If these fancy apples must be put into barrels with the No. 1 quality and sold for the same price, the profits of thinning are not great, but if there are enough growers shipping together that all the fancy apples may be put into a pack that will be offered in large enough quantities to impress the market, thinning is more likely to pay. In some experiments, thinning has reduced the total number of bushels or barrels picked; in other cases it has not; that is, the increased size of the fruit has offset the reduced number. In practically all cases, however, more money is received for the fruit of thinned trees than for the fruit from similar trees not thinned. The fruit from thinned trees has in all experiments shown an appreciably better color than from unthinned trees.

Thinning is of special importance in the case of certain varieties that have a strong tendency to overbear, and hence to produce fruit that is small and irregular. On the other hand, there are some varieties that are not, as a rule, heavy bearers, and with these thinning may not be necessary. Even in the latter case, however, the removal of a few fruits at points where several are clustered together may be advisable.

Thinning is usually done from the first of June to the first of July; the earlier it is done after all the fruit has fallen that is going to fall in early summer, the better.

The usual practice is to thin clusters to only one fruit and leave no two fruits closer than 6 inches apart. In some cases a space of 8 or 9 inches between fruits is maintained.

The cost of thinning varies from 9 or 10 cents to 60 or 70 cents per tree, depending on the size and form of the tree.

Very large trees 20 or 25 years old will cost 50 cents or more; properly pruned trees 8 or 10 years old can be thinned for 10 or 12 cents.

FERTILIZATION OF APPLE ORCHARDS

52. The elements that are likely to be deficient in a soil are nitrogen, phosphorus, potassium, and occasionally calcium, and with most crops a deficiency of one of these materials becomes the limiting factor for that crop. Thus, applying an excess of potassium when phosphorus is the element that is deficient does little or no good and in some cases may actually do harm. A healthy, vigorous wood growth indicates that sufficient nitrogen is present, and deficiency of nitrogen results in limited growth. The lack of potassium or phosphorus also results in a rather weak growth, but the effect of a deficiency of these two elements on growth is not so marked as is the case when nitrogen is lacking. Potassium is thought by many growers to give a better color to the fruit, but careful experiments do not bear out this opinion. Lime is useful as a means of correcting acid soils, but since an apple soil is seldom acid, lime may be entirely omitted in a discussion of the fertilization of an apple orchard.

53. It is well known that apple trees bear profitable crops on a very poor soil, yet analyses show that an apple crop actually takes away annually from the soil more nitrogen and potassium than a crop of grain. It has been found that an annual crop of 15 bushels of wheat to the acre takes away from the soil in 20 years 659.58 pounds of nitrogen, 210.6 pounds of phosphoric acid, and 323 pounds of potassium. An acre of apple trees from 13 to 33 years old and bearing a crop of 15 bushels to the tree in 20 years takes away from the soil, in the fruit, 498.6 pounds of nitrogen, 38.25 pounds of phosphoric acid, and 728.55 pounds of potassium; and in the leaves, 456.75 pounds of nitrogen, 126 pounds of phosphoric acid, and 441 pounds of potassium. It will be seen, assuming that all the leaves go back to the soil, that considerably more potassium is removed by the apple crop than by the wheat

crop. Reasoning from these results it would seem that potassium is a very important orchard fertilizer and that all elements of fertility would have to be applied, especially to an old orchard and that, even in a medium rich soil, fertilizers may need to be applied. Further, since the orchardist is dealing with a crop that is so valuable that a small percentage of increased yield would pay for the fertilizers, the use of fertilizer in an orchard would seem to offer better results than the use of fertilizer with grain crops, with which often a considerably increased yield will not pay for the cost of the fertilizer, since the value of the crop per acre in any case is not great.

54. It may be well now to turn to experimental results to see whether these assumptions are borne out by experience. It is plain that before an experiment with fertilizers can be given any credence it must be carried on for a considerable number of years, certainly not less than four or five. A number of long-time experiments of a rather extensive nature have been tried. One of the first of these to be published was an experiment carried on for 12 years with trees more than 40 years of age to begin with, on a soil of medium richness in Western New York. This experiment was in the use of potassium and phosphate only. Some varieties showed an apparent gain from the treatment; others showed a loss. The net result from the use of fertilizer was a benefit of about \$99 for 5 acres, and the cost of the fertilizer was about \$74.50, leaving a profit of only about \$24.50. This did not pay for applying the fertilizer, and as the difference is within the range of error the experiment seems to indicate that the advisability of using fertilizers in an orchard having a soil of reasonable fertility is somewhat questionable. Another experiment for 15 years with young trees, showed no benefits from the use of either potash, phosphorus, or nitrogen.

55. At the Woburn Experiment Station, England, in a rich soil a long-time experiment failed to show any beneficial results, even on old trees, from the use of any form of fertilizer; however, it is reported that on a thin soil the same

experiment station has secured profits from the use of fertilizers. The Massachusetts Experiment Station secured profits from the use of potassium, nitrogen, and phosphorus, and especially from the use of barnyard manure. At the Pennsylvania Experiment Station, nitrogen has proved to be a valuable fertilizer to apply to an orchard; potassium has not uniformly shown any benefits; and the use of phosphate has not shown marked benefits. The use of barnyard manure and a combined fertilizer on a sod-mulch orchard gave remarkably beneficial results—very much more beneficial results than on a cultivated orchard on the same kind of soil. In fact, the use of nitrogen-bearing fertilizer with a sod-mulch seemed entirely to offset the lack of cultivation, though this may not be the case under other circumstances. At no experiment station has potash shown any positive effect in improving the color of fruit.

It would seem from these experiments that on any orchard soil the use of either potassium or phosphorus fertilizers or both may be profitable if either or both of these elements are deficient in the soil. Nitrogen can more often be used with profit than either potassium or phosphorus. It is found, however, that in practically all cases nitrogen injuriously affects the color of the fruit. At the Pennsylvania Experiment Station it seemed to be evident that the use of potassium and phosphate combined with nitrogen to some extent reduces the injurious effect of nitrogen. Stable manure, though more expensive than chemical nitrogen, seems in the case of a sod-mulch orchard to give more beneficial results, and in the case of a cultivated orchard the beneficial results from the use of chemical fertilizers were as great as from the use of stable manure.

56. It is scarcely possible to make any recommendations that will apply to all soils. However, first it would be well for the orchardist to assume that his trees, if they are making a good, healthy growth and bearing well, do not need fertilizing; this is true, also, if the trees are not bearing well, on account of frost, insect, or fungous injuries, etc. If the soil is reasonably fertile and the orchard neglected, good pruning,

cultivation, and spraying should certainly be resorted to before fertilizing. However, if the orchard is well cared for and the trees are not sufficiently vigorous, it may be profitable to use commercial fertilizer, especially fertilizer containing nitrogen. In all cases it is well to watch the results that are obtained by the application of different mixtures and by this means determine what the soil needs. The following is suggested for the first application: Actual nitrogen, 30 pounds per acre; actual phosphoric acid, 60 to 75 pounds per acre; actual potash, 50 pounds per acre.

These amounts of nitrogen, phosphoric acid, and potash can be secured by using any of the following combinations:

1. Nitrate of soda ($15\frac{1}{2}$ per cent. nitrogen), 100 pounds; dried blood ($12\frac{1}{2}$ per cent. nitrogen), 100 pounds; steamed bone meal (24 per cent. phosphoric acid and 1 per cent. nitrogen), 250 to 300 pounds; sulphate of potash (50 per cent. potash) 100 pounds.
2. Nitrate of soda (15 per cent. nitrogen), 100 pounds; dried blood ($12\frac{1}{2}$ per cent. nitrogen), 120 pounds; acid phosphate (15 per cent. phosphoric acid), 400 to 500 pounds; sulphate of potash (50 per cent. potash), 100 pounds.
3. A 6-12-10 fertilizer, 500 pounds.

If the soil is known to be high in either phosphorus or potash—that is, if a grain or vegetable crop will not respond vigorously to applications of either phosphorus or potash—the amounts of these elements could be greatly reduced in the fertilizer tried, and the amount of nitrogen, even in a poor soil, largely reduced by substituting leguminous cover crops. It may be well at times to alternate stable manure with chemical fertilizers the first and third years, using about 10 tons to the acre.

57. Time of Applying Fertilizers.—It is not possible to give absolute directions as to the best time for applying chemical fertilizers, because various conditions will require different practices. However, so far as experience has gone, it seems to indicate that the best time is shortly after the blooming period of the trees. Dried blood or sulphate or

ammonia may be applied earlier, but if nitrate of soda is used it should be applied at the time suggested, for at this time the trees can make use of it readily and this fertilizer does not remain in the soil for any great length of time.

58. Fertilizing of Young Trees.—In a great many orchards where it will not pay to fertilize the old trees, especially in the case of nitrogen, the ill effects of which will more than offset the beneficial results it will pay handsomely to fertilize young trees, at the time of setting, with about 1 to $1\frac{1}{2}$ pounds of dried blood or $\frac{1}{2}$ to $\frac{3}{4}$ pound of nitrate of soda, in a radius of $1\frac{1}{2}$ or 2 feet, and repeat the application the second year. Of course, after the first and second years the amounts of fertilizer used should be increased, since the area on which it is spread will be larger as the roots grow. The use of leguminous crops on the soil may entirely replace the use of nitrogen in many cases.

RENOVATION OF OLD APPLE ORCHARDS

59. The renovation of old apple orchards is a somewhat important phase of orcharding and one that can often be made profitable. It is by no means true that all old, neglected orchards can be made to pay satisfactory returns by renovation. In many cases neglect has gone so far and insect and fungous troubles have worked such havoc that time and money spent in renovation would be largely if not wholly wasted. But, on the other hand, there are many instances in which a judicious expenditure in the renovation of an old orchard has been made to pay handsome returns. Whether or not renovation will pay in any particular case will depend on numerous factors. Perhaps one of the most important of these is the question of capital available. In many cases at least the first year after renovation begins no crop can be expected, and if a man has not the capital to give the orchard this necessary care without a crop to defray the expenses, he should probably hesitate to begin. The condition of the trees with reference to age, vigor, height, shape and distance apart, are

additional factors that should have serious consideration. If the trees are not old, for example, it may not be necessary to lose a crop in order to get them back into good condition. Especially is this true in a fairly good soil. But if the trees have run up too high a head to be handled profitably they will have to be cut back and the center to some extent cut out. This treatment may involve the loss of the crop the summer following although this is not necessarily the case.

60. The stand of trees is another important consideration in determining whether it will pay to renovate an old orchard. Generally speaking, unless as much as 50 or 60 per cent. of the trees are in good, healthy condition, and 15 or 20 per cent. more of them are sufficiently healthy to be brought back to good condition by careful treatment, it will hardly pay to attempt to bring the orchard into profitable bearing, since cultivation, etc. for the poor stand will be as expensive as for a good stand.

61. The kind of soil on which the old orchard is located is also an important factor. If the soil is not a reasonably good orchard soil, generally it will not pay to go to the expense of renovating an old orchard, especially if the soil is such that it could be profitably devoted to some other crop. Of course, there will be exceptions to this, as in cases, where on account of good local markets, an orchard would be profitable even on a poor orchard soil.

62. The question of being located where there is reasonable certainty of getting a crop nearly every year is of very great importance. If the orchard is located in a valley where there is almost sure to be frequent damage from late spring frosts, it will generally not be profitable to renovate it unless it is intended to make use of orchard heaters. Generally speaking, it may be said that in a section where the orchard is run down because there had been so many crop failures, that is, because it has not paid to keep it up, it would not, as a rule, be advisable to spend money in renovation.

63. The prevalence of insect pests and fungous diseases, is of some importance. It is true that these troubles can be successfully combated in many cases, but if the trees are badly injured by borers or other insects that leave permanent injury to the bodies of the trees, or if the orchard is badly infected with different forms of apple canker, its renovation may be inadvisable, since in many cases it would be impossible to bring the trees into a healthy condition and keep them that way for any length of time.

64. It may also be said that to a large extent the success of such a venture will depend on the man who undertakes it. It will require a man who is fairly well acquainted with the orchard business and who knows what he wants to do in the matter of renovating the orchard to get the best results. He should also be very certain that he is going to have the time and inclination to give the orchard the necessary care after it is worked over. In most cases it has been observed that if the orchard is under new management the renovation is more likely to be thorough and effective, and the trees to have the necessary care than if the man who has been neglecting it undertakes the renovation.

65. Methods of Renovating an Old Apple Orchard. No general rules can be laid down for working over an old orchard, for each orchard will require special treatment, depending on its condition. In undertaking any renovating, it should be the intention to give the trees the best of care, to get the soil in good physical condition, and generally to take all necessary measures to promote as healthy a growth as in the case of growing young trees. Dead limbs should be removed, and it is likely that many limbs that are not dead should be cut out in order to give room for others and bring the trees to a size and shape that will permit of economical spraying, thinning, and harvesting. Undesirable stubs, splinters, etc. that have resulted from improper pruning or breaking of limbs by winds or other causes should be removed and all wounds painted. The severity of the treatment will depend on the condition of the orchard. As suggested, a young orchard,

especially if it is not badly infected with canker or seriously infested with insects like borers or fruit-tree bark beetles, does not need anything like so severe cutting as an old orchard. Often merely thinning and cutting out to the proper shape, getting the soil in good condition, and beginning the practice of spraying will be sufficient to bring the orchard into healthy condition. On the other hand, where the orchard is badly injured, severe cutting may be necessary.

66. In many cases the trees will be set too close and it may be necessary to cut out some of them, but the orchardist

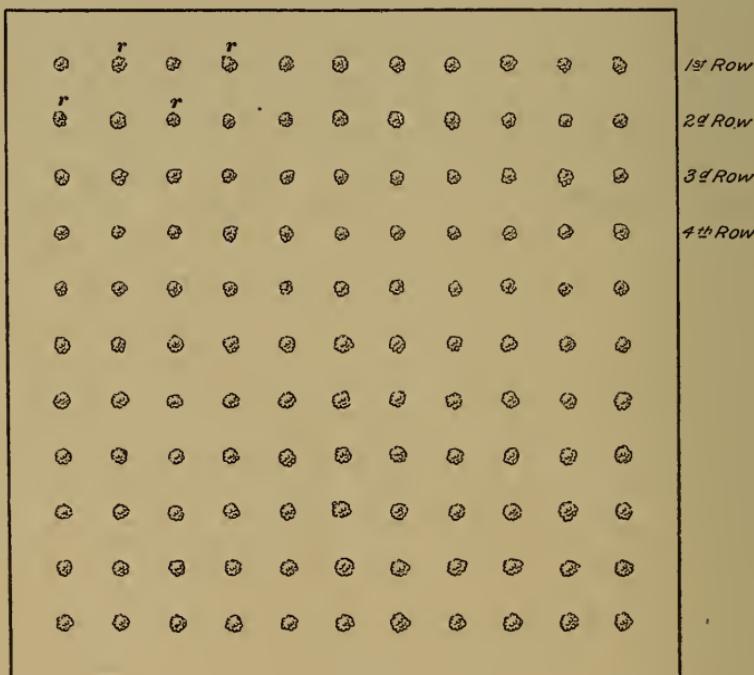


FIG. 10

should carefully consider whether it will be better to cut out some of the trees or cut all of them back severely and keep them down in size. It is not advisable to attempt to grow trees too large on a thin soil. Small trees can be more profitably handled than large ones, provided there are enough trees on the ground to make up for the lack of size. In any soil a distance of 25 feet each way is sufficient if the trees are

kept down in size. However, in many cases it is unquestionably necessary to cut out some of the trees. If the orchard is set in hexagonal form it is usually a good plan to cut out every other row; if the trees are set in the square form it may be better to cut out alternate trees in each row, as indicated in Fig. 10, in which *r* designates the trees that are to be removed. In shaping the remaining trees, if they are young and it is desired to prune them to an open head, the center



FIG. 11

may be cut out say 8 or 10 feet high and all the weaker limbs and some of the superfluous stronger ones cut out so as to leave only six or seven limbs that are well spaced around the body of the tree. Usually five or six limbs will be sufficient, and these should be shortened back a little to make them stocky and to make them push out new growth further down the limb.

In Fig. 11 is shown a tree in which five limbs have been retained and the points to which these limbs are to be cut back are indicated at *a*. Old and badly neglected trees should be cut back rather severely. A tree of this kind is illustrated in Fig. 12, and the extent to which it may be advisable to cut it back is shown by the white line drawn through the head. It will also be advisable to thin out the limbs considerably in the center to form, to some extent, an open head.



FIG. 12

67. As an illustration of the severe cutting back that was necessary in a certain old orchard, the views shown in Figs. 13 and 14 are of interest. Fig. 13 shows the orchard before pruning and well illustrates the extreme height and undesirable form commonly assumed by neglected apple trees. In Fig. 14 is shown a view of the same trees after they were pruned. It will be seen that the high limbs have been shortened back and much of the thick, bushy growth removed. In the case

FIG. 13



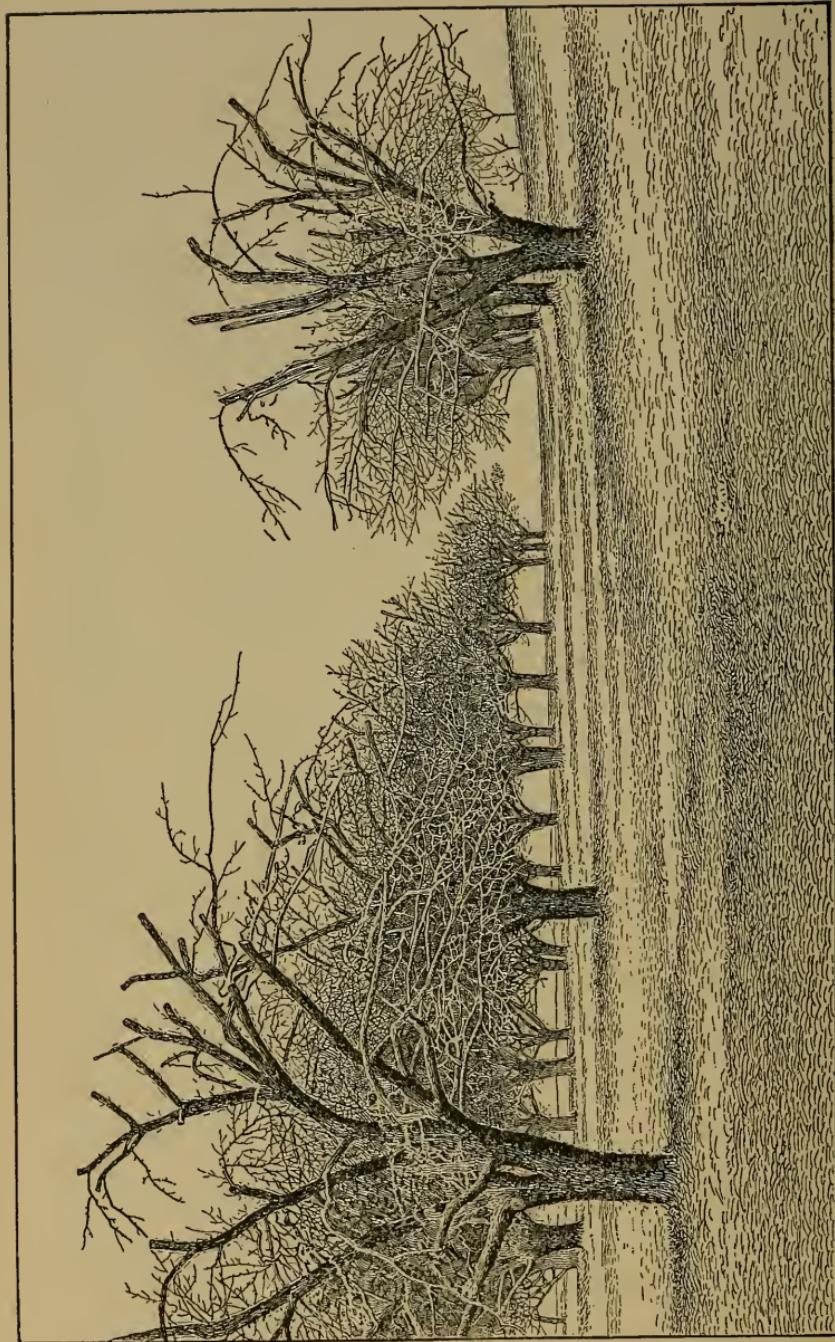


FIG. 14

of such trees as are shown in Fig. 14 it would undoubtedly be advisable to still further reduce the length of the highest limbs, but to avoid injury to the trees from excessively severe pruning the latter work may be delayed 2 or 3 years or until the trees have somewhat recovered from the shock of the first pruning.

Severe pruning should be done somewhat gradually; that is, it is better to do a part of it each year for 2 or 3 years than to do it all in a single season. In the case of trees that require very severe pruning, it is often advisable to leave more of the lower limbs than will be desired in the renovated tree. Later, when the tree has put out new top growth, the superfluous lower limbs may be removed.

Another point to be avoided in severe pruning operations is the making of numerous large wounds close together. If this is done the effect is somewhat the same as girdling the tree. If it is found necessary to remove several large limbs that join the trunk close together, the danger of girdling may be avoided by cutting some of them in such a way as to leave a stub 1 or 2 feet long. Later, when the wounds on the trunk have healed or are nearly healed the stubs should be sawed off close to the trunk. All large wounds made in this work should be painted each year until entirely healed.

68. Soil Treatment for Renovated Orchards.—In working over an old orchard, the owner should bear in mind the practices that have been recommended for the general care of an apple orchard. If the soil is badly run down, probably the most desirable thing would be to grow a crop of cowpeas or vetch or some other leguminous crop for the sake of its beneficial effect on the soil. The use of orchard fertilizers may in some cases be resorted to and in all probability there is no time when fertilizing will pay better than at the beginning of the spring after the trees have been cut back in winter; especially is the use of barnyard manure or nitrogenous fertilizer to be recommended then. In a soil very low in any other essential material, as potassium or phosphorus, these should be applied to secure best results from

the nitrogen. In many cases, resorting to winter cover crops will show very marked benefits, especially in the case of a soil on a south hill slope, and the use of cover crops should certainly be part of the system of management if the orchard is located on a hillside.

69. Spraying Methods for Renovated Orchards.—It will generally be profitable to give a dormant spraying for old, neglected trees in a renovated orchard. When serious pests such as San José scale are present they should be combated as directed in another Section. A very heavy dormant spray should be given for insects that will be nestled in the bark, and for spores of fungi. This will be beneficial also in clearing the bark of algae and lichens that grow on it. Even after an orchard has been cut back so severely that no crop is expected, at least one spraying to keep apple scab and other fungous diseases off the foliage might be made to give the orchard the very best opportunity to make a good growth the first summer. Even if the orchard does not have a crop, it should have the same care the second summer after renovation as would be given to any bearing apple orchard.

70. Top Working of Trees.—In many cases the varieties found in an old orchard will not be those that are profitable. In other cases the orchard may be made up of a single variety that is self-sterile, so that the introduction of some other variety for cross-fertilization is necessary. There are undoubtedly many orchards that are failures because of lack of proper pollination, and in going over an old orchard the varieties should be carefully studied with reference to this question. If necessary, varieties should be selected that are known to be satisfactory for the cross-pollination of the varieties predominating in the orchard, and the former should be top-worked into the latter. The time for doing this will vary from late winter, say the latter part of February or any time in March, up to possibly the middle of May, in the northern section of the country, though early spring grafting is usually considered best.

In working over the trees the grafts should be set in stubs that are directed outwards and will form desirable limbs. The limbs in the center that are not wanted may well be left temporarily as sap pullers—that is, for the purpose of furnishing foliage to supply nourishment; they should be cut out when they have served the purpose. The first season after the grafts have been set they should make a large growth. Many water sprouts will come from the old stubs; those at the end of the stub should be carefully rubbed off so they will not interfere with the growth of the grafts. Part of those along the side of the limb may also be rubbed off; it is often desirable to leave some of the water sprouts and either to bud them in the summer with the same varieties as the grafts inserted or to whip-graft on them the winter following.

If more than one of the grafts on the end of a stub live, probably some of them should be kept cut back to give one the advantage, and usually after a few years when the stub is about healed over all except one may be cut off. The tree should then be kept pruned as much as it would be in the case of a good open-headed tree; it should be kept from becoming too dense in the center, and after the grafts have made considerable growth, say after 3 or 4 years, it should be clipped back a little each year to keep it from getting too tall and to keep the growth down on the tree.

APPLE PESTS AND INJURIES

INJURIES DUE TO LOW TEMPERATURE

INJURIES DURING DORMANT PERIOD OF PLANTS

1. Killing of Fruit Buds.—Severe winter weather may cause various degrees of injury to fruit buds. The degree of the injury depends on the temperature, the prevalence of winds, whether the air is dry or moist, the condition of the tree at the beginning of cold weather, and probably other factors or conditions that are not known. If the injury is very severe the fruit buds and the fruit spurs, of those trees that bear fruit spurs, may be killed. In less severe cases the fruit buds only are entirely killed. In the latter cases the buds turn brown throughout and do not open at the time for blossoming. In other cases the injury is less severe and the buds open into blossoms, but many of the pistils, or the central portion of each blossom which, if uninjured, matures into the fruit, are killed. In Fig. 1 are shown several blossoms, two in cross-section, one of these having a small brown or black pistil *a* which has been frozen, and the other a healthy green pistil *b*.

2. Killing of Twigs and Large Stems.—The killing of the wood of trees, like the killing of the buds, depends on various factors, the most important of which are the condition of the tree at the time that cold weather arrives, intense cold, very wet soil, and the heaving of land by frost.

Dead wood is darker than live, active wood and usually can be easily recognized. If the wood is killed during the early

part of the winter the injury is probably caused by cold weather coming before the trees have reached a sufficiently dormant state to withstand the cold. At the time the leaves fall, especially if they are killed by frost, the trees cannot withstand nearly so low a temperature as they can a month later. That is, the trees must be allowed several weeks after the leaves fall in which to attain a dormant condition so that they can withstand severe cold without injury. In those regions of the United States and Canada where severe cold weather is likely to occur in the early part of the winter, it is advisable for the fruit grower to resort to methods of culture

that will force the trees into an early dormant condition. This end is usually obtained by stopping cultivation and by planting, usually in August, a cover crop that will make a rapid growth during the autumn.

If the wood is killed during the latter part of winter, the injury is probably caused by a very cold period that lasts for several weeks, during which time the twigs and limbs lose much moisture by evaporation, and as the branches are frozen they cannot take up moisture to replace that which was evaporated.

It has been observed that the greatest injury from winter-killing of fruit trees occurs in orchards that are not well drained and to those trees that stand in low or wet places in orchards that are otherwise well drained. In such cases the trees are kept in a growing condition until late in the fall and do not attain a sufficiently dormant condition by the time cold weather arrives. A very wet soil in an orchard can usually be benefited by thorough and proper drainage.



FIG. 1

3. Killing of Roots.—The roots of fruit trees will generally not survive a temperature lower than from 25° to 22° F. Therefore, if the roots are exposed to the air they will be killed by the winter temperature in almost any apple-growing section in the United States or Canada, but the temperature of the soil does not fall nearly so low as that of the air and rarely becomes low enough to kill tree roots. In fact, it is desirable that a few inches of the surface soil be frozen during the winter, as such freezing has a tendency to force the trees into a dormant condition. It has been observed that if a heavy fall of snow occurs before the soil freezes the soil does not become frozen, and more trees are killed than if the soil freezes. However, there is more danger from winter-killing of the roots if the soil freezes several feet deep than if only from 4 to 6 inches at the surface becomes frozen, because the deeper the ground freezes the colder the frozen portion becomes.

INJURIES DURING THE PERIOD OF VISIBLE ACTIVITY OF PLANTS

4. The injuries that occur to plants while they are in a noticeably active condition, that is, after the buds have begun to swell in the spring and until the plants have assumed a dormant condition in the fall, are commonly known as **frost injuries**, although injuries that are caused by freezing temperature but without the deposits of frosts may occur at this time of the year.

5. Frost Injury to Apple Buds.—Ordinarily, fruit buds are not injured by the low temperatures that usually accompany spring frosts. However, if spring frosts are accompanied by such low temperatures that it is customary to speak of them as freezes, rather than as frosts, the unopened buds may be killed. Apple buds, even after they are open far enough for the white color of the petals to show at the tip of the buds, are not often seriously injured by a temperature of 25° F. However, instances are on record where a temperature as low as 18° F. has occurred after the color of the petals was

distinguishable without seriously injuring the buds. But, in such cases, a combination of unusual conditions may have existed that prevented the killing of the pistils of the fruit buds. It is safe to say, however, that apple buds, after the white begins to show at the tips of the buds, are nearly always killed, or at least seriously injured, by a temperature of 20° F. or less.

6. Frost Injury to Apple Blossoms.—It is not definitely known exactly how low a temperature apple blossoms will endure without injury. But a careful observer and investigator states that while blossoms are fully expanded a com-

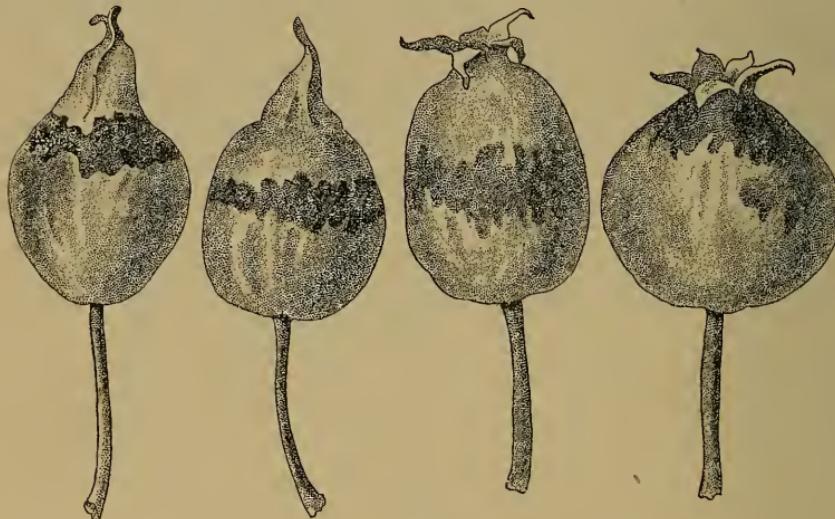


FIG. 2

paratively light frost will kill them and that a temperature of 28° F. is nearly always fatal. Apple blossoms are more easily killed than are peach blossoms, although the peach crop is more often killed by spring frosts than is the apple crop. This is due, however, to the fact that peach trees usually bloom earlier in the season than do apple trees. Sometimes there is apparently a second crop of apple blossoms that appears after the first crop has been killed by frost. In many cases, however, the so-called second crop of blossoms is simply those blossoms that would normally have come out a little late. In other cases the late blossoms develop from those buds that formed in the axils of the leaves the previous year.

7. Frost Injury to Young Apples.—After the blossoms have fallen and the young apples have set, the fruit may not suffer from severe freezes. The claim has even been made by some observers that fruit shortly after it has set will not be seriously injured by being frozen solid. Recovery from such freezes certainly cannot always be the case, because it is a fairly well-established fact that the injury such as is shown on the young apples in Fig. 2 was caused by frost. Such apples often continue to grow, but the mature apples will show a russet, coky zone, as illustrated in Fig. 3. Other observers and investigators claim that very young apples, that is, apples immediately after the blossoms have fallen and the fruit is said to have set, are more easily injured by frost than are the blossoms. Newly-set apples are certainly very likely to be killed by a temperature of from 30° to 28° F.

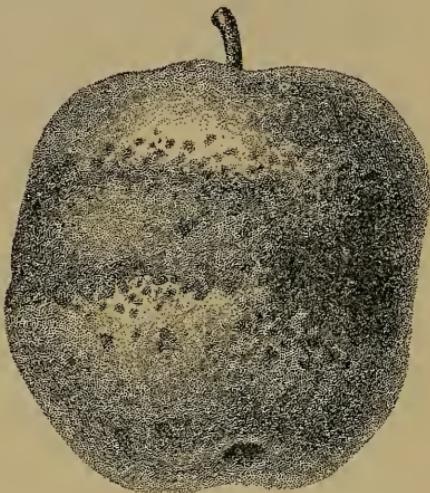


FIG. 3

PREVENTION OF FROST INJURIES

8. More or less moisture always exists in the atmosphere in the form of an invisible vapor. When this invisible vapor is condensed by a falling temperature, clouds, or fogs, are formed; if the moisture in the clouds is further condensed at a temperature above the freezing point rain is formed; and if condensed at a temperature at or below the freezing point snow is formed. If the moisture of the atmosphere that is in immediate contact with the surface of the earth is condensed at temperatures above the freezing point, dew is formed, and if this moisture is condensed at or below a freezing temperature frost is formed. **Frost** is, therefore, the moisture of the air condensed at or below 32° F. on the surface of the earth or on plants or other objects.

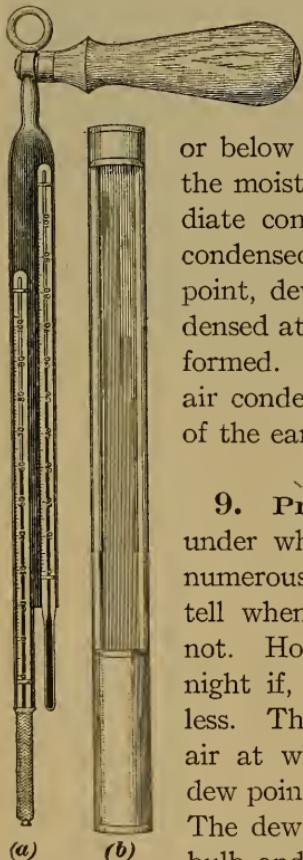


FIG. 4

9. **Prediction of Frost.**—The conditions under which damaging frosts may occur are so numerous and varied that it is very difficult to tell when frosts will occur and when they will not. However, frost may be expected during the night if, at nightfall, the dew point is 42° F. or less. The **dew point** is the temperature of the air at which dew is deposited. And when the dew point falls to 32° F. or lower, frost will occur. The dew point is determined by means of wet-bulb and dry-bulb thermometers and a specially prepared table known as a dew-point table.

The most accurate kind of an instrument for the determination of the dew point is shown in Fig. 4 (a), and is known as a sling psychrometer. This instrument consists of a wet-bulb and a dry-bulb thermometer, securely fastened to a

support, which, in turn, is attached to a handle in such a way that the thermometers and their support may be whirled on one end of the handle. A case in which the sling psychrometer may be kept while not in use is shown in (b). The bulb of one of the thermometers is covered with a thin piece of cloth and just before it is used this bulb is dipped in a cup of water and

TABLE I
DETERMINATION OF THE DEW POINT

Difference in the Reading of the Dry- and Wet-Bulb Thermometers Degrees F.	Reading of Dry-Bulb Thermometer. Degrees F.											
	15	20	25	30	35	40	45	50	55	60	65	70
Degrees of Temperature F. at Which Dew is Deposited												
1.....	11	16	22	27	32	38	43	48	53	58	63	69
2.....	6	12	18	24	30	35	41	46	52	57	62	67
3.....	7	14	21	27	33	39	44	50	55	60	66	
4.....	1	10	17	24	30	36	42	48	53	59	64	
5.....		4	13	20	27	33	40	46	51	57	62	
6.....			7	16	24	30	37	43	49	55	61	
7.....				1	11	20	27	34	41	47	53	59
8.....					5	16	24	31	39	45	51	57
9.....						11	20	28	36	43	49	55
10.....							4	16	25	33	40	47
11.....								11	21	30	38	45
12.....									4	17	27	35
13.....										11	23	32
14.....											5	18
15.....											12	24
												34
												42

the cloth covering thoroughly saturated; hence, the name wet bulb. Care must be used to avoid getting water on the naked, or dry, bulb. The instrument is then whirled rapidly for from 15 to 20 seconds and the temperature of the wet-bulb thermometer noted; the whirling and the noting of the temperature of the wet-bulb thermometer is repeated until the

temperature is the same at two consecutive readings. This temperature, unless the air is saturated, will be less than that of the dry-bulb thermometer, and the difference between the reading of the wet-bulb and that of the dry-bulb thermometer should be accurately determined. After these data are secured, the dew point may be determined by the aid of Table I as follows: If the temperature of the dry-bulb thermometer is 49° F. and the temperature of the wet-bulb thermometer is 41° F., the difference in temperature is 8° F. The dew point will be found in the table at the intersection of the horizontal row in which 8 occurs in the column of figures at the left side of the table and the vertical column headed by the number nearest the temperature of the dry-bulb thermometer, 50°. The dew point in this case would be 31° F., and frost should be expected to occur that night.

10. Average Dates of the Occurrence of Frosts.

Table II, which is taken from the United States Weather Bureau reports, shows the date of the latest recorded killing frost in spring, the date of the earliest recorded killing frost in autumn, the average date of the occurrence of the last killing frost in the spring, and the average date of the occurrence of the first killing frost in autumn at various points in different states in the United States.

11. Factors Affecting the Occurrence of Killing Frosts.

—Certain factors such as the altitude, the latitude, the topography of the land, the position in relation to large or deep bodies of water, and the motion of the air all exert their influence on the occurrence of frosts in any locality. The humidity of the air is also a factor that exerts an influence on the occurrence of killing frosts. If the air is saturated, that is, if it contains all the moisture it will hold, there is little danger from frost so long as the temperature of the air remains above the freezing point. If the temperature is at or below the freezing point, a saturated atmosphere may retard frosts to a certain extent, but just how much is not known.

The reason that saturated air may prevent injury from frosts is that evaporation of moisture from a plant takes place readily

TABLE II
DATES OF LATE SPRING AND EARLY AUTUMN FROSTS

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Alabama:				
Mobile.....	Mar. 28	Oct. 31	Feb. 24	Nov. 30
Montgomery.....	Apr. 5	Oct. 21	Mar. 11	Nov. 8
Arizona:				
Phoenix.....	Mar. 31	Nov. 9	Feb. 18	Dec. 7
Yuma.....	None	None	None	None
Arkansas:				
Fort Smith.....	Apr. 6	Oct. 15	Mar. 4	Nov. 4
Little Rock.....	Apr. 14	Oct. 22	Mar. 20	Nov. 10
California:				
Eureka.....	May 1	Nov. 7	Apr. 2	Dec. 8
Fresno.....	Apr. 14	Nov. 18	Mar. 4	Dec. 15
Los Angeles.....	Apr. 8	None	Apr. 8	None
Red Bluff.....	Apr. 25	Nov. 15	Feb. 26	Dec. 6
Sacramento.....	Apr. 26	Oct. 28	Feb. 16	Nov. 15
San Diego.....	None	None	None	None
San Francisco.....	Apr. 20	Nov. 18	Jan. 8	Dec. 26
San Luis Obispo....	Apr. 8	Nov. 19	Feb. 20	Dec. 27
Colorado:				
Denver.....	June 6	Sept. 12	May 6	Oct. 5
Grand Junction.....	May 15	Sept. 27	Apr. 14	Oct. 21
Pueblo.....	May 23	Sept. 12	Apr. 26	Oct. 5
Connecticut:				
New Haven.....	May 30	Sept. 15	Apr. 20	Oct. 17
District of Columbia:				
Washington.....	May 11	Oct. 2	Apr. 7	Oct. 21
Florida:				
Jacksonville.....	Apr. 6	Nov. 12	Feb. 14	Dec. 6
Jupiter.....	Apr. 7	Nov. 18	Feb. 14	Dec. 29
Pensacola.....	Apr. 6	Nov. 12	Feb. 23	Dec. 5
Tampa.....	Mar. 19	Nov. 28	Feb. 8	Jan. 9

TABLE II—(*Continued*)

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Georgia:				
Atlanta.....	Apr. 15	Oct. 11	Mar. 24	Nov. 7
Augusta.....	Apr. 17	Oct. 8	Mar. 20	Nov. 9
Macon.....	Apr. 18	Nov. 5	Mar. 15	Nov. 14
Savannah.....	Apr. 5	Nov. 1	Feb. 27	Nov. 26
Illinois:				
Cairo.....	Apr. 19	Sept. 30	Mar. 29	Oct. 28
Chicago.....	May 29	Sept. 18	Apr. 18	Oct. 15
Springfield.....	May 22	Sept. 25	Apr. 20	Oct. 16
Indiana:				
Evansville.....	Apr. 21	Sept. 30	Apr. 10	Oct. 30
Indianapolis.....	May 21	Sept. 21	Apr. 16	Oct. 19
Iowa:				
Davenport.....	May 22	Sept. 18	Apr. 22	Oct. 14
Des Moines.....	May 22	Sept. 12	Apr. 28	Oct. 8
Dubuque.....	May 21	Sept. 27	Apr. 20	Oct. 13
Keokuk.....	May 4	Sept. 18	Apr. 13	Oct. 15
Sioux City.....	May 21	Sept. 13	May 1	Sept. 27
Kansas:				
Concordia.....	May 19	Sept. 27	Apr. 24	Oct. 14
Dodge.....	May 27	Sept. 23	Apr. 17	Oct. 15
Topeka.....	May 19	Sept. 28	Apr. 8	Oct. 13
Wichita.....	May 15	Sept. 23	Apr. 6	Oct. 19
Kentucky:				
Lexington.....	May 20	Sept. 30	Apr. 18	Oct. 23
Louisville.....	May 14	Sept. 24	Apr. 6	Oct. 29
Louisiana:				
New Orleans.....	Mar. 27	Nov. 19	Jan. 24	Dec. 15
Shreveport.....	Apr. 2	Oct. 20	Mar. 4	Nov. 11
Maine:				
Eastport.....	June 19	Sept. 8	Apr. 28	Oct. 12
Portland.....	May 31	Sept. 11	Apr. 14	Oct. 18

TABLE II—(*Continued*)

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Maryland:				
Baltimore.....	May 3	Oct. 6	Apr. 4	Nov. 4
Massachusetts:				
Boston.....	May 11	Sept. 30	Apr. 26	Oct. 22
Nantucket.....	Apr. 24	Oct. 1	Apr. 10	Nov. 5
Michigan:				
Alpena.....	June 9	Sept. 6	May 14	Sept. 26
Detroit.....	May 31	Sept. 21	Apr. 30	Oct. 11
Escanaba.....	June 16	Sept. 9	May 14	Oct. 1
Grand Haven.....	May 28	Sept. 23	Apr. 28	Oct. 10
Marquette.....	June 11	Aug. 22	May 15	Oct. 2
Port Huron.....	June 6	Sept. 22	May 8	Oct. 9
Sault Ste. Marie....	May 29	Sept. 5	May 16	Sept. 24
Minnesota:				
Duluth.....	June 8	Sept. 15	May 3	Oct. 5
Minneapolis.....	May 20	Sept. 13	Apr. 27	Oct. 8
Moorhead.....	June 8	Aug. 25	May 14	Sept. 22
St. Paul.....	May 25	Sept. 20	May 6	Oct. 5
Mississippi:				
Meridian.....	Apr. 10	Oct. 8	Mar. 20	Nov. 2
Vicksburg.....	Apr. 6	Oct. 19	Mar. 6	Nov. 12
Missouri:				
Columbia.....	May 9	Sept. 28	Apr. 14	Oct. 15
Hannibal.....	May 14	Sept. 30	Apr. 14	Oct. 15
Kansas City.....	May 4	Sept. 30	Apr. 10	Oct. 24
Springfield.....	May 19	Sept. 30	Apr. 16	Oct. 13
St. Louis.....	May 22	Sept. 30	Apr. 2	Oct. 27
Montana:				
Havre.....	June 6	Aug. 27	May 14	Sept. 13
Helena.....	June 9	Sept. 5	May 10	Sept. 25
Nebraska:				
Lincoln.....	May 10	Sept. 12	Apr. 18	Oct. 9
North Platte.....	May 23	Sept. 10	May 1	Sept. 28

TABLE II—(*Continued*)

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Nebraska— <i>Continued</i>				
Omaha.....	May 19	Sept. 18	Apr. 15	Oct. 12
Valentine.....	June 21	Sept. 12	May 9	Sept. 18
New Mexico:				
Santa Fe.....	May 18	Sept. 27	Apr. 15	Oct. 19
Nevada:				
Winnemucca.....	June 20	Aug. 22	May 15	Sept. 24
New Jersey:				
Atlantic City.....	Apr. 25	Oct. 1	Apr. 11	Nov. 4
New York:				
Albany.....	May 30	Sept. 23	Apr. 24	Oct. 17
Binghamton.....	May 21	Sept. 16	Apr. 27	Oct. 6
Buffalo.....	May 29	Sept. 23	Apr. 25	Oct. 16
New York.....	Apr. 30	Oct. 5	Apr. 10	Nov. 6
Oswego.....	May 29	Sept. 25	Apr. 27	Oct. 19
Rochester.....	May 30	Sept. 26	May 1	Oct. 19
North Carolina:				
Charlotte.....	Apr. 26	Oct. 8	Apr. 1	Nov. 4
Hatteras.....	Apr. 19	Nov. 7	Feb. 28	Dec. 11
Raleigh.....	May 6	Oct. 8	Apr. 5	Nov. 4
Wilmington.....	May 1	Oct. 16	Mar. 27	Nov. 15
North Dakota:				
Bismarck.....	June 7	Aug. 23	May 15	Sept. 21
Williston.....	June 10	Aug. 18	May 18	Sept. 14
Ohio:				
Cincinnati.....	Apr. 24	Sept. 30	Apr. 14	Oct. 25
Cleveland.....	May 22	Oct. 2	Apr. 16	Oct. 31
Columbus.....	May 17	Sept. 21	Apr. 16	Oct. 16
Sandusky.....	May 17	Oct. 8	Apr. 14	Oct. 26
Toledo.....	May 29	Sept. 9	Apr. 24	Oct. 15
Oklahoma:				
Oklahoma.....	Apr. 30	Oct. 7	Apr. 2	Oct. 31

TABLE II—(Continued)

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Oregon:				
Baker City.....	June 24	Sept. 4	May 25	Sept. 27
Portland.....	May 9	Oct. 13	Mar. 17	Nov. 16
Roseburg.....	May 16	Sept. 25	Apr. 15	Oct. 30
Pennsylvania:				
Erie.....	May 17	Oct. 12	Apr. 22	Oct. 29
Harrisburg.....	Apr. 26	Oct. 3	Apr. 10	Oct. 24
Philadelphia.....	Apr. 29	Oct. 3	Apr. 8	Oct. 30
Pittsburg.....	May 29	Sept. 25	Apr. 26	Oct. 19
Rhode Island:				
Block Island.....	May 11	Oct. 30	Apr. 12	Nov. 16
Narragansett.....	May 30	Sept. 21	Apr. 23	Oct. 16
South Carolina:				
Charleston.....	Apr. 2	Nov. 9	Mar. 1	Nov. 30
Columbia.....	Apr. 17	Oct. 19	Mar. 23	Nov. 8
South Dakota:				
Huron.....	June 8	Aug. 23	May 13	Sept. 20
Pierre.....	May 19	Sept. 12	Apr. 30	Sept. 30
Rapid City.....	May 21	Sept. 13	May 1	Sept. 20
Tennessee:				
Chattanooga.....	May 14	Sept. 30	Apr. 2	Oct. 26
Memphis.....	Apr. 16	Oct. 2	Mar. 24	Oct. 28
Nashville.....	May 14	Oct. 8	Apr. 2	Oct. 24
Knoxville.....	Apr. 24	Oct. 1	Apr. 3	Oct. 27
Texas:				
Abilene.....	Apr. 16	Oct. 24	Mar. 15	Nov. 15
Amarillo.....	May 23	Oct. 16	Apr. 16	Nov. 1
Corpus Christi.....	Mar. 19	Nov. 30	Feb. 27	Dec. 25
El Paso.....	Apr. 22	Oct. 23	Mar. 20	Nov. 10
Fort Worth.....	May 1	Oct. 22	Mar. 18	Nov. 19
Galveston.....	Mar. 1	Dec. 4	Feb. 5	Dec. 25
Palestine.....	May 30	Oct. 20	Mar. 13	Nov. 13
San Antonio.....	Mar. 20	Nov. 9	Feb. 25	Nov. 30

TABLE II—(*Continued*)

Station	Date of Latest Recorded Killing Frost in Spring	Date of Earliest Recorded Killing Frost in Autumn	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn
Utah:				
Salt Lake City.....	June 18	Sept. 22	Apr. 23	Oct. 18
Vermont:				
Northfield.....	June 7	Aug. 27	May 13	Sept. 16
Virginia:				
Lynchburg.....	May 7	Oct. 4	Apr. 14	Nov. 1
Norfolk.....	Apr. 26	Oct. 15	Mar. 27	Nov. 12
Wytheville.....	May 26	Sept. 14	Apr. 23	Oct. 7
Washington:				
Seattle.....	May 27	Oct. 18	Mar. 21	Nov. 22
Spokane.....	June 8	Sept. 7	Mar. 23	Oct. 17
Tatoosh Island.....	Apr. 19	Nov. 1	Mar. 14	Dec. 15
Walla Walla.....	May 12	Sept. 28	Apr. 4	Nov. 7
West Virginia:				
Elkins.....	May 24	Sept. 28	May 18	Oct. 10
Parkersburg.....	May 22	Sept. 24	Apr. 11	Oct. 17
Wisconsin:				
Green Bay.....	May 30	Sept. 16	May 5	Oct. 4
La Crosse.....	June 1	Sept. 21	May 2	Oct. 8
Madison.....	May 13	Sept. 29	Apr. 21	Oct. 17
Milwaukee.....	May 29	Sept. 25	Apr. 29	Oct. 10
Wyoming:				
Cheyenne.....	June 11	Aug. 29	May 22	Sept. 16
Lander.....	June 18	Aug. 23	May 19	Sept. 11

if the air is dry, and this evaporation lowers the temperature of the plant. If, however, the air is saturated, evaporation of moisture from plants cannot take place. The degree of protection will, of course, depend on the degree of saturation, or of humidity.

12. Means of Preventing Frost Injuries.—In almost every section of the United States there is some danger of loss in the business of fruit growing from injuries to the fruit crop due to frosts. In fact, the killing of the fruit crop by frosts is an important factor in determining whether or not fruit growing in any locality will be a success. The preventing of a fruit crop from being killed by frost not only saves the value of the crop for the current year, but makes the fruit-growing industry in the community more stable and enables the business to be more easily carried on in succeeding years; because most, or at least some, fruit growers, desire to borrow money occasionally, and loans are more easily secured if the fruit growing business is a well-established industry in the community.

13. Mulching with such crops as winter vetch or rye grown in an orchard has a tendency to keep the soil cool, and by so doing may tend to retard the time of blooming. This action, however, is very slight, as it is largely the temperature of the twigs and buds and not that of the soil that determines the time of blooming.

14. Whitewashing of fruit trees may have the effect of slightly retarding their blooming period. However, the retardation is so little that the whitewashing of the trees for this purpose is not generally considered to be practical. The principle involved in the use of whitewash is that the white surface of the bark, twigs, and buds, after they are whitewashed, will not absorb the rays of the sun and consequently will not attain a temperature as high as the surrounding atmosphere.

15. Irrigation is used as a means of preventing frost injuries in irrigated regions when the temperature gets so low that frost is expected. The water used in irrigating gives off heat and usually prevents severe injury, provided the temperature does not go below 28° F.

16. Spraying of fruit plants with water is effective in preventing injury from frosts, but the spray must be applied as long as the low temperature continues. If the spray is stopped, the temperature of the plants is quickly reduced and

wet plants will not stand without injury as low a temperature as dry plants.

17. Smudging, which is the burning of some material that will make a cloud of dense, moist smoke, is a means of preventing damage by frost. This is an old practice and is effective in preventing frost injuries where the conditions in and around the fruit plantation are such that a uniform, dense smudge can be retained as a blanket over the plantation until all danger of frost is past. The fuel used should be of a kind that burns slowly; it is claimed that better results will be obtained if damp fuel is used or if water is added to the fire so that a steam or vapor is formed than if the fire is allowed to blaze. Such material as damp leaves, old hay, straw, manure, sawdust, brush, grass, in fact, any slow-burning material may be used as fuel in the making of smudges. A mixture of 1 part of coal tar and 2 parts of sawdust has been recommended as a very desirable smudge fuel. The fuel should be on hand in the orchard so that the fires may be lighted as soon as indications of frost appear.

Smudging is more often effective in preventing frost if the orchard is located on level land than if on a slope or on rolling land, because in the latter cases there are more likely to be air-currents, which prevent the smudge from settling like a blanket over the orchard. The principle involved in smudging is that the cloud of smoke and vapor acts as a blanket spread over the orchard and thus prevents the heat stored in the soil and in the trees of the orchard from radiating.

18. Orchard heating is warming the air of an orchard by means of fires kept burning at the time frost is likely to occur. Although this is an old practice, it has been gaining much favor in the past few years, and is now considered one of the most practical means of preventing frosts in orchards.

The fuels used for orchard heating in the United States are the western oils, often spoken of as distillates, crude petroleum of the Mississippi Valley and the Eastern States, fuel oil obtained from the refining of petroleum, and coal, wood, straw, manure, and shavings; oil and coal are the important fuels used for the

purpose. In burning, all of the fuels mentioned produce a dense, heavy smoke and in some sections the practice of orchard heating is known as *smudging*.

If coal is used in orchard heating, it is generally necessary to have some sort of kindling to start the coal in the heaters, and it is also necessary to light the heaters a few hours before the temperature reaches the danger point; it is, however, impossible to know whether or not to light the heaters on some occasions. For this reason some grade of oil is most largely used for orchard-heating purposes, although coal may be used with success in regions where coal is relatively cheap and oil is relatively expensive. Wood may be burned in small heaps on the ground, but some kind of burners must be provided if oil or coal is used as a fuel. The burners, or heaters,

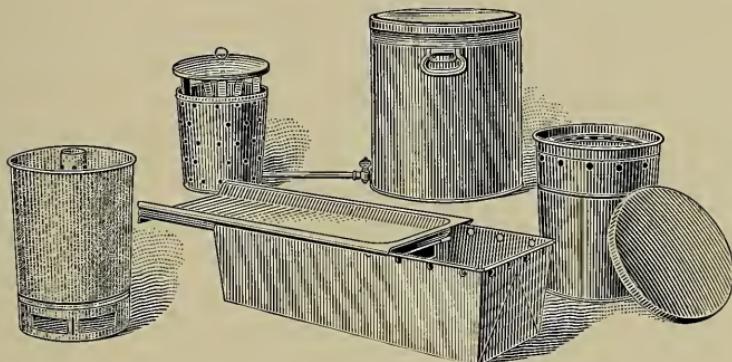


FIG. 5

in which the oil is burned are usually some form of galvanized-iron or of ordinary sheet-iron pots or vessels that will hold from 1 to 4 or more gallons of oil. The 2-gallon size is, probably, under most conditions, the most desirable size. A large number of heaters for the burning of oil has been made with various shapes and devices that are supposed or claimed to make the heating more effective. Several oil-burning heaters are shown in Fig. 5, and a coal-burning heater is shown in Fig. 6.

It is recommended that heaters of a simple form of construction be used; that they be supplied with a lid that can be easily placed on the heater while the oil is burning and that

cannot be blown off by the wind. The more desirable heaters are supplied with some appliance for reducing the burning surface, especially if the heater has a capacity of 2 or more gallons of oil.

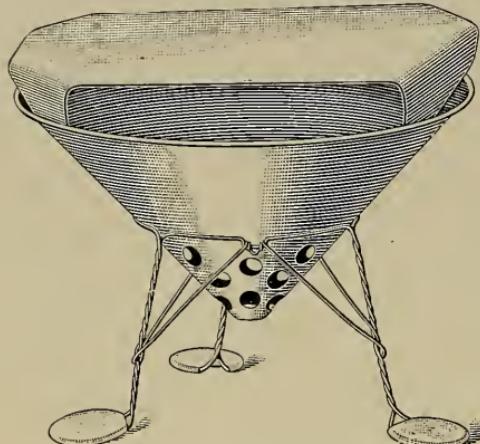


FIG. 6

heaters to the acre may be sufficient. Experience indicates, however, that there should be in any orchard at least one heater for each tree and that an average of one hundred heaters to the acre is desirable. Also, the orchardist should have a torch for lighting the oil in the heaters and a small gasoline can, such as the one shown in Fig. 7, from which a small quantity of gasoline may be placed on the oil in the heater to facilitate lighting.

To be prepared to combat frost successfully by means of oil heaters the orchardist must provide for the storage of a sufficient quantity of oil for heating the orchard at least three times. The oil should be on hand before it is needed for the fighting of frosts. Assuming that $1\frac{1}{2}$ gallons of oil is burned in each heater and that one hundred heaters are used per acre, it would require, therefore, 150 gallons of oil to the acre for each heating of the orchard. Thus, for a 10-acre orchard it would be

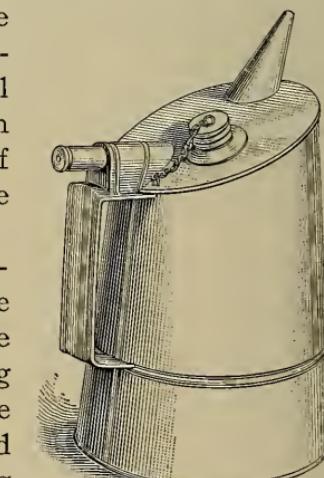
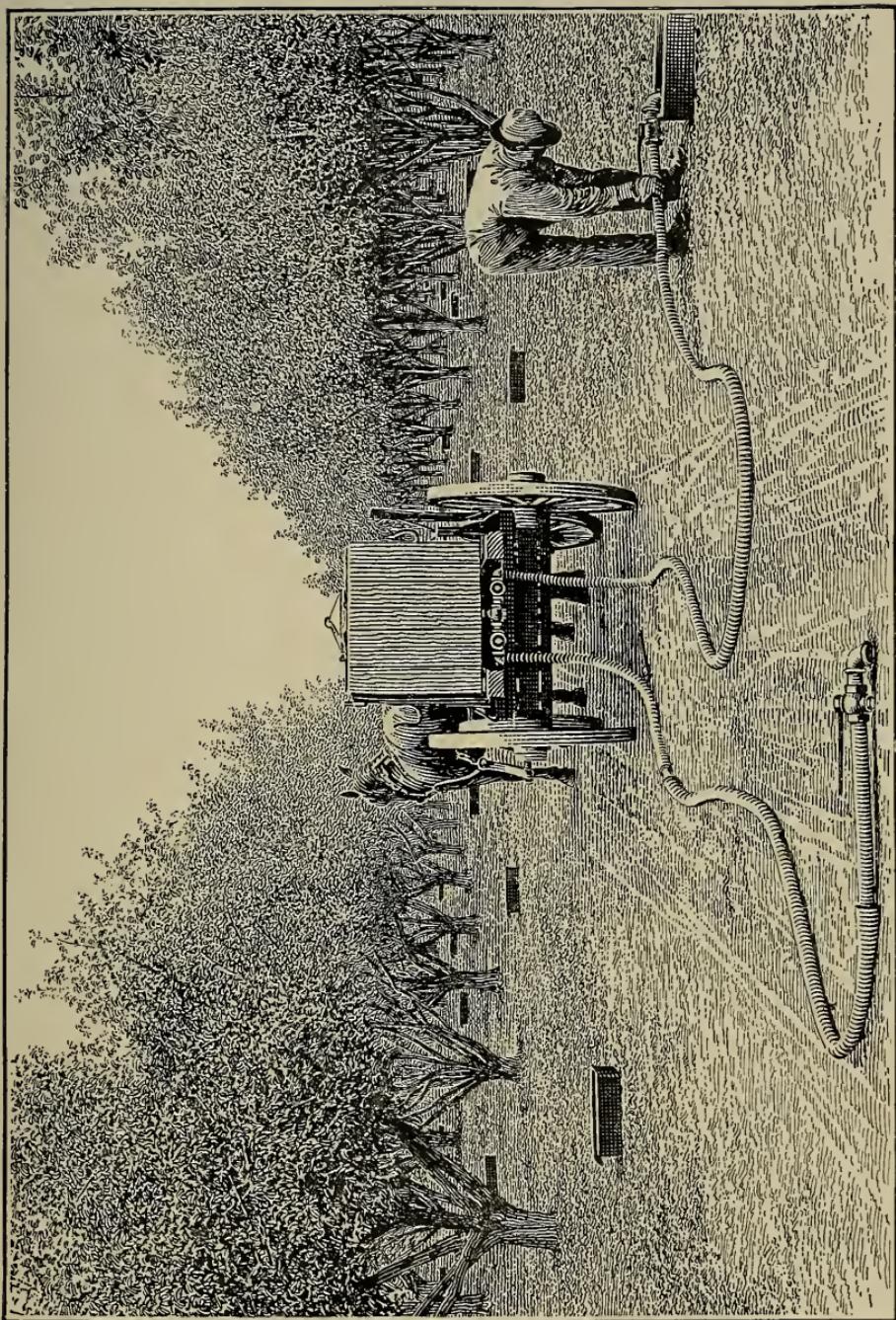


FIG. 7

FIG. 8



advisable to have on hand 4,500 gallons of oil; this should be stored in a large cement cistern or in large galvanized-iron tanks. In addition, there should be a good 400-gallon tank that could be readily mounted on a wagon and used for distributing the oil in the orchard. This tank should be equipped with one or two hose and nozzles, such as the outfit shown in Fig. 8.

20. The cost of the equipment necessary for fighting frost by means of heating the air will, of course, vary with the cost of labor and material. Approximately, the cost for the orchard-heating equipment for a 10-acre orchard may be summarized as follows:

1,000 orchard heaters.....	\$150 to \$400
1 storage tank for oil.....	75 to 175
1 hauling tank.....	40 to 75
2 torches and gasoline cans	2 to 3
Total.....	\$267 to \$653

The cement storage tank will last indefinitely, but the other equipment will, in time, have to be replaced. Therefore, in estimating the annual cost of the equipment for heating a 10-acre orchard, the depreciation of equipment should be considered. Assuming that the permanent equipment other than the cement storage tank will last for 10 years, the annual cost of heating a 10-acre orchard may be summarized as follows:

Depreciation of equipment	\$ 19.20 to \$ 47.80
4,500 gallons of oil (usually less oil is used) ..	112.50 to 225.00

2 men placing and fill-

ing heaters, 1 day \$3.00 to \$ 4.00

1 team placing and fill-

ing heaters, 1 day 1.50 to 2.00

2 men lighting and

tending heaters .. 3.00 to 4.00

Total for one heating \$7.50 to \$10.00

Labor for three heatings..... 22.50 to 30.00

Hauling oil from railroad station to farm.... 16.00 to 24.00

Approximate total annual cost for

10-acre orchard \$170.20 to \$326.80

Approximate total annual cost per acre \$ 17.00 to 32.70

In addition to the equipment mentioned, a few good tested thermometers should be provided. It is necessary to have them tested, because thermometers of fair grade often vary from 2 to 5 degrees; such thermometers should be checked with some tested thermometer and the corrections, if any, made for each one. These thermometers may then be placed at various places throughout the orchard. There are on the market thermometers equipped with an alarm bell that rings when the temperature drops to a dangerous degree. These alarms cannot always be depended on; therefore, too much reliance should not be placed in them, however convenient they may be.

21. Heaters may be placed in an orchard and filled any time after the buds have begun to swell and are in danger from injury by frost; but they should be in place and ready for use before the time for their use occurs. They should be placed under the trees but not so near them that the trunks will be injured by the blaze from the burning oil. If coal is used as a fuel, a small quantity of kindling must be placed under the coal. The fires are lighted by means of a torch usually made of a bunch of waste fastened to the end of a wire and saturated with oil. This torch is lighted and placed, partly submerged in the oil heater, and immediately under the kindling in the coal heaters. If a small quantity of gasoline is poured on the surface of the oil from a small can firing takes place very quickly. The use of the gasoline, however, is dangerous unless care is exercised in using it. Its use should not be entrusted to children or to persons who will not use care in keeping the gasoline can and the torch separated as far as possible.

If a dangerous temperature is expected, one man should remain in the orchard during the night and carefully note the temperature as indicated by the thermometers. If a frost is imminent, other men should be wakened to help in lighting the heaters. During the heating the attendants should carefully watch the rise or fall of the temperature and regulate the fires accordingly. If the temperature rises beyond the danger point, the fires should be put out and thus save fuel. The



FIG. 9

heaters may, if necessary, be refilled while they are burning by running oil into them through a hose attached to a tank, such as that shown in Fig. 8. An orchard in which the fires are burning is shown in Fig. 9.

To prolong the usefulness of orchard heaters, they must be well cared for throughout the year. Most orchardists collect the heaters after all danger from frosts is past and store them in a shed in or near the orchard. Any shed or building that will keep out the rain and snow will answer this purpose. Other orchardists, after they have finished using their oil heaters for any season, fill them with oil and place them near the trunks of the trees. This method of storing saves time and does not necessitate so large a storage tank for oil as where the heaters are stored in a shed, and if the heaters are of galvanized iron and are provided with neatly fitting lids they will remain in good shape for several years.

INSECTS AND DISEASES OF THE APPLE

INSECTS AFFECTING THE APPLE

22. It is estimated that over \$700,000,000 is annually lost from the work of insects in the United States. Probably no crop suffers greater from the ravages of insects than does the apple crop. It is estimated that in New York State alone an annual loss from the codling moth, including the expense of spraying, is at least \$3,000,000. Although there are a great number of insects that may at times infest apple orchards, most of these insects are controlled by spraying the trees with an insecticide. It is important, therefore, that a fruit grower become acquainted with each of the more common apple insects and the means of combating them.

23. Apple-Tree Borers.—The apple tree is attacked by three species of borers, the *round-headed apple-tree borer*, the *spotted apple-tree borer*, and the *flat-headed apple-tree borer*.

The adult **round-headed apple-tree borer**, shown in Fig. 10 (a), is a long-horned beetle with two white stripes down its back and is from $\frac{3}{4}$ to nearly 1 inch in length. The adults vary a month or so in the time they emerge from the pupal stage, but they usually come out about the last of May. Due to the fact that the adults may emerge during a period of from 1 to 2 months, the eggs are deposited during a period extending for nearly 2 months from about the last of May. The eggs are pale rusty brown in color, $\frac{1}{8}$ inch long, about one-third as wide as long, and about one-third as thick as wide. They are deposited at night, usually in the bark of the trunk near the ground, but they are sometimes deposited higher up. A side view of the larva is shown in Fig. 10 (b), and a view from above is shown in (c). During the first year after hatching these larvas, or borers, burrow into the sap wood and downwards. The second year a borer usually works more or less into the hard wood and upwards; the third year it gnaws out to the bark, where a cocoon is made and from which the adult emerges. It is, therefore, 3 years from the time an egg is deposited until the insect hatching from that egg develops and emerges as an adult. A single borer seldom kills a tree, but if several borers, as is often the case, are in one young apple tree, it is very likely to be killed.

Another insect that closely resembles the round-headed apple-tree borer is the **spotted apple-tree borer**, the adult of which is illustrated in Fig. 11. As may be seen by comparing Fig. 10 (a) with Fig. 11, the chief difference in the appearance between the round-headed and the spotted apple-tree borers is that each of the two white stripes on the back of the former insect are represented by three white

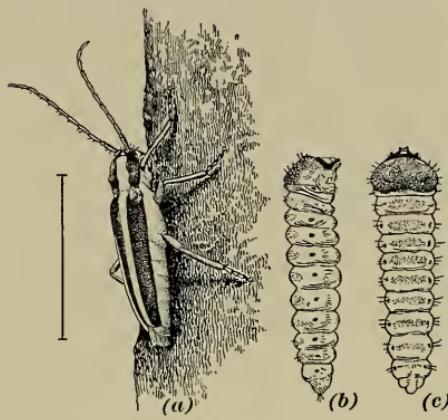


FIG. 10



FIG. 11

spots on the latter insect. The eggs of the spotted apple-tree borer are laid in pairs about $\frac{1}{2}$ inch apart along the trunk and large branches of the tree, and as soon as these eggs hatch the larvae, which in appearance can scarcely be distinguished from the larvae of the round-headed apple-tree borer, work in opposite directions around the branch. Like the round-headed apple-tree borer, the spotted apple-tree borer spends the first year in the sap wood, the second year in the hard wood, and the adult insect emerges the third year.

The adult **flat-headed apple-tree borer** is illustrated in Fig. 12 (a) and the larva in (b). The adults are about $\frac{1}{2}$ inch in length and appear during the spring, at about the time the adults of the round-headed apple-tree borer appear, and deposit their eggs during the daytime on the bark and limbs of the trees.

The larvae of the flat-headed apple-tree borer usually mine into the sap wood only. They hibernate on the approach of cold weather and in late spring form pupas within the infested trees. The adults emerge from the pupas and eat their way out. The work of the flat-headed apple-tree borer can be told from that of the round-headed apple-tree borers by the shape of the holes that they mine; the hole of the round-headed apple-tree borer is round and that of the flat-headed apple-tree borer is oblate.

24. Although apple-tree borers are not particularly numerous, they do exist in considerable numbers in some sections. And from the fact that they cannot be killed by spraying, their work seriously weakens the trees of apple orchards, and if they are not successfully combated they will eventually destroy many trees, especially young trees.

The presence of the insects in the trees may be detected by the injured appearance of the bark near the ground. If the insects are in the tree, there may be present at the surface

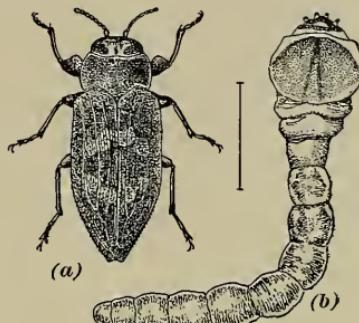


FIG. 12

of the bark sawdust-like cuttings of the borers; the bark may present a dead, shriveled appearance; jelly-like secretions may be present on the surface of the bark; or it may present a bruised or injured appearance.

Borers are combated by two general methods: (1) By preventing them from getting into the trees, and (2) by destroying them after they get into the trees.

The preventive method consists in attempting to keep the adult insects from depositing their eggs in the bark of the trees. This may be accomplished by placing mechanical barriers around the trees or by washing them with some solution that has a tendency to repel the insects. One of the most common barriers consists of from two to four thicknesses of newspaper loosely wrapped around the trunks of the trees. The paper should be tied in place by a cord, or string, that will yield or break with the expansion of tree as it grows. A small mound of earth should be thrown around the outside of the paper at the bottom of the trunk of the tree and the paper at the top of the trunk should be tied rather tightly with the string so that the beetle cannot get down behind the paper and obtain access to the tree. Wood veneer or wire netting may be used instead of the paper to place around the trees. That part of the trunk immediately above the wrapping and the lower limbs of the tree should be treated with some deterrent. A wash made by reducing soft soap or fish-oil or whale-oil soap to the consistency of thick paint by the addition of washing soda or of caustic soda in solution has been recommended as a successful repellent to the adult insects of the apple-tree borers.

Clean cultivation around the trees is one of the best means of preventing injury from borers. Grass, weeds, or water sprouts should not be allowed to grow and accumulate around the base of the trees, as the accumulation of such material forms a suitable place for the insects to lay their eggs.

If a tree is found that is injured beyond recovery it should be taken out and destroyed by fire, so that the larvae that it may contain will be killed before they have an opportunity to develop and infest other trees. The insects in slightly infested trees may be cut out and destroyed.

25. San José Scale.—The one insect that has probably caused more damage to apple orchards than any other insect is the San José scale. The insects proper are very small and yellowish in color. For a short time after their birth the young insects may be seen crawling about. They have six legs; and a head with eyes, antennæ, and a long, thread-like beak through which they take their food. But in from 12 to 36 hours after their birth the young insects attach themselves to the bark, fruit, or leaves of a tree and secrete from their bodies waxy filaments. This waxy secretion soon forms a scale over the insect and it is this scale that the orchardist usually sees and not the insect proper, which, after the scale is formed, loses its legs, eyes, and antennæ, and only the thread-like beak and an anal plate are distinct and these only under a high-power microscope. In fact, the insects become only masses of organized protoplasm and present but little resemblance to the young crawling insects.

The insects, when they attach themselves to leaves, fruit, and smooth young bark, cause a reddish color to appear around the scales, and their presence is usually easily recognized by this red-colored tissue.

The immature San José scales are most easily recognized by orchardists, because the immature scales are circular, almost black, have a nipple-like prominence near the center of the scale, and the nipple is surrounded by one, two, or three depressed circular rings. A section of an apple limb that is



FIG. 13

infested with San José scale is shown magnified several times in Fig. 13.

The reason that the San José scale is so damaging in an orchard is that the insects are very small and to unobserving persons are not noticed until they are present by the millions and the trees have begun to die from the damage done by the insects. It is estimated that there are from two to five and possibly more generations of the insects each year, and that the progeny of a single female insect in the latitude of Washington, D. C., may be almost three and one-quarter billion insects in a single year. It is easy to understand, therefore, why it is that a tree with only a few San José scale on it in the spring may be almost covered with them by fall.

On apple trees, San José scale usually infest the small twigs; rarely are the scales found on the thick, rough bark, and the leaves and fruit are infested only on very badly infested trees. The old scales are of a grayish color and in badly infested orchards the scales give a gray, ashy color to the limbs of the trees.

San José scale is pretty generally distributed over the United States, and those sections where it has not been found have no assurance of immunity. There are several ways of distributing the pest, probably the most common of which is by means of nursery stock. Young trees should be purchased only from a nurseryman that can show a certificate of inspection. Orchardists should learn to recognize San José scale and to examine carefully each tree received from a nursery. During the crawling stage of the life of the insects, that is, from their birth until they attach themselves, they may crawl from tree to tree where the branches touch; the young insects may crawl onto the feet of birds and be carried several miles and crawl off onto another tree; the young insects may be blown from tree to tree by the wind; and they may also be distributed on infested fruit, but this means of distribution is not considered to be of great importance.

26. If an orchard is found to be infested by San José scale, it should be sprayed thoroughly. The most popular spray is lime-sulphur, although miscible oils are used extensively.

The miscible oils are less disagreeable to apply than lime-sulphur but there is a slightly greater danger of injuring the twigs with the former than with the latter.

Lime-sulphur of a specific gravity of about 1.03 should be applied in the fall soon after the leaves have fallen or in the spring before the buds begin to swell noticeably. If commercial brands of lime-sulphur are used, it is usually necessary to dilute 1 gallon of the concentrate solution with 9 gallons of water to secure a solution with a specific gravity of 1.03, but to insure the proper specific gravity of the spray mixture a hydrometer should be used.

Although the spring spraying has been found a little more effective than the fall spraying, some orchardists recommend and practice fall spraying. The reason for this practice is that if anything should prevent the completion of the spraying during the fall the work could be finished in the spring, whereas, if something should prevent spraying the entire orchard in the spring, the spraying with a strong spray solution would have to go undone. However, lime-sulphur with a specific gravity of from 1.007 to 1.01 may be applied to the trees during the summer months without injury to the foliage and may check the increase of San José scale.

Miscible oils are used principally as winter sprays in combating San José scale. Commercial brands should be used as directed by the manufacturer, but if home-made miscible oil is used it should be diluted from ten to twelve times, that is, from 9 to 11 gallons of water should be added to each gallon of miscible oil to make from 10 to 12 gallons of the emulsion, or spray.

27. Oyster-Shell Scale.—Perhaps the most common scale insect that is found in apple orchards is the oyster-shell scale, also known as the *oyster-shell bark louse*. The characteristic appearance of a part of an apple limb infested by this insect is illustrated in Fig. 14 (a), and a single female, with a section of the scale removed to show the eggs, is shown enlarged in (b). The scales that cover the female insects are dark brown or grayish in color, about $\frac{1}{6}$ inch in length, and shaped

somewhat like an oyster shell. The scales of the male insect are much smaller than those of the female.

In the latter part of August the female insects lay from forty to one hundred small, reddish eggs; these remain over winter under the scale, and during the latter part of May hatch into small lice-like insects, which crawl out from under the scale and move slowly over the bark for a few hours, when they attach themselves to the bark and remain there for the rest of their lives. In the first molting, the insects lose their eyes, legs, and antennae, and immediately begin secreting the material of which the scale is formed. The females die soon after

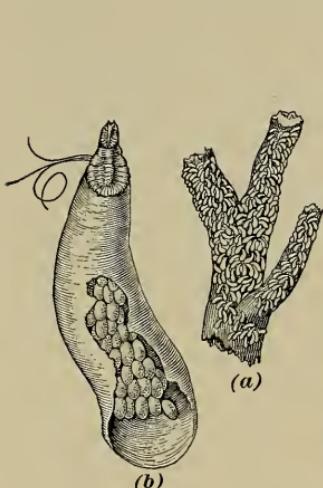


FIG. 14

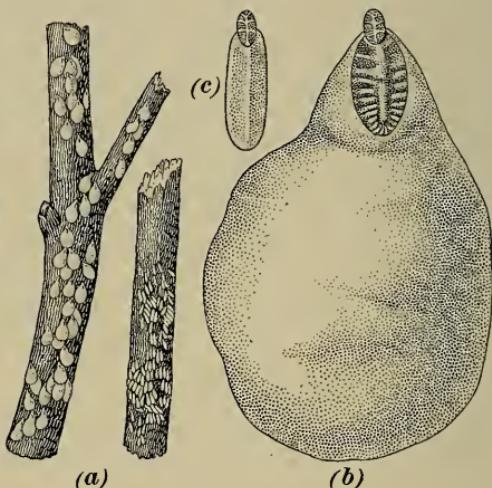


FIG. 15

laying their eggs, and, as there is only one brood in most parts of the United States, the oyster-shell scale does not multiply anything like so rapidly as the San José scale. As is the case with the San José scale, the oyster-shell scale insects may be carried from tree to tree during the period that they are crawling, by birds or by the wind.

Although the oyster-shell scale is very widely distributed throughout the United States, it does not often occur in sufficiently large numbers to do great injury to orchards. However, if orchards are neglected, oyster-shell scale may become somewhat serious.

The same methods of control are recommended for the oyster-shell scale as for the San José scale, and if spraying is practiced for the destruction of San José scale little need be done for the oyster-shell scale.

28. Scurfy Scale.—Scurfy scale are illustrated in natural size in Fig. 15 (a). The larger scales are the females and the smaller scales are the males. An enlarged female scale is shown in (b) and a male scale in (c).

Scurfy scale, although very common in apple orchards, is not considered a serious pest; in fact, it has never been reported to have caused serious damage to apple trees. The life history of the scurfy scale is practically the same as that of the oyster-shell scale, and the methods of control are also the same.

29. Codling Moth.—The insect that causes wormy apples is known as the codling moth. This insect exists in practically all parts of the world in which apples are grown. The mature codling moth, shown in Fig. 16, is about $\frac{3}{4}$ inch across the expanded wings, which have somewhat the appearance of grayish-brown watered silk, and emerges from 1 to 3 weeks after apples blossom. Within a few days after emerging the moths begin to deposit their eggs, most of them on the foliage of the tree.

In from 5 to 10 days after being laid the eggs hatch into small whitish worms, or larvas, about $\frac{1}{16}$ inch long. If the eggs are hatched on the leaves, the larvas usually feed a little on the tender leaves and then crawl to the nearest apple. Most of the larvas enter the apples through the calyx, within which they feed for a short time and then eat their way into the core of the apple. Here the larvas usually consume a portion of the flesh of the apple and the apple seeds, and, becoming fully grown at from 3 to 4 weeks of age, eat their way out through the sides of the apples, leaving round exit holes. Full-grown larvas, which are about $\frac{3}{4}$ inch long and are whitish or pinkish in color, find a convenient place to spin their cocoons in which they

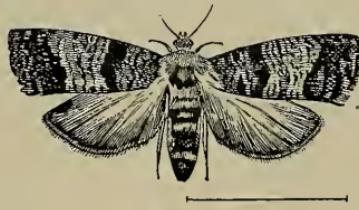
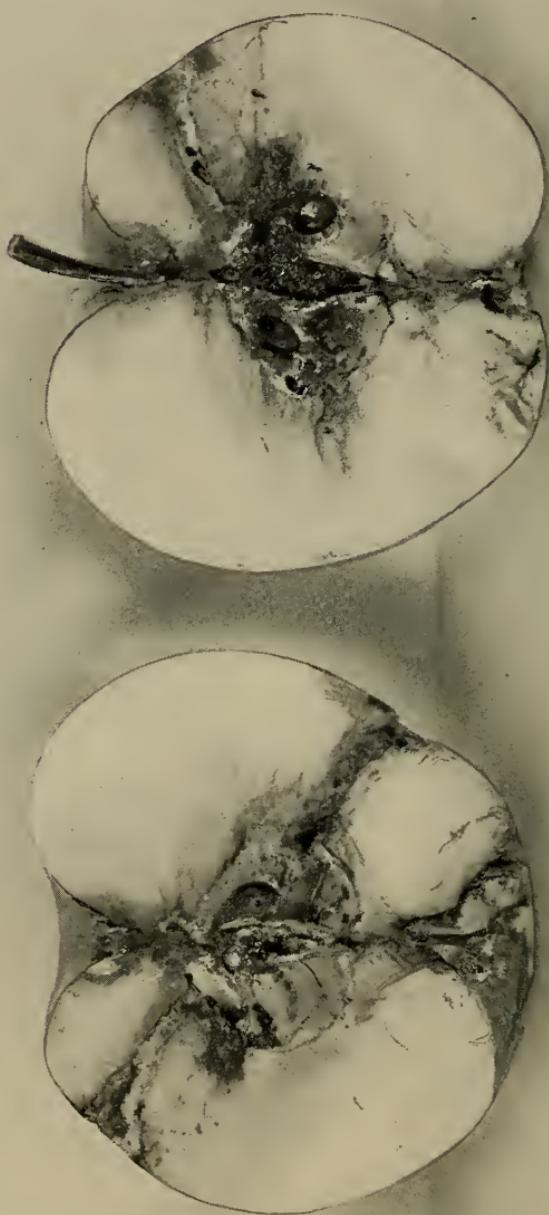


FIG. 16

FIG. 17



transform into pupas and usually emerge as mature moths in about 8 weeks from the time the eggs were laid. The characteristic appearance of the interior of an apple injured by codling moth larvae is shown in Fig. 17.

Under certain conditions, a few of the larvae of the first brood hibernate during the winter, but in most parts of the United States only the larvae of the second brood of moths hibernate over winter. A number of cocoons are often found on the under side of a piece of bark as it is pulled from an apple tree. The larvae of the second brood of codling moth usually enter the apples from the side or from the stem end.

30. Codling moths are combated by the use of arsenical poisons and by destroying the hibernating larvae. All loose bark on the trunk of apple trees in an infested orchard should be removed from the trees and burned so as to destroy the larvae that may be attached to the under side of the bark.

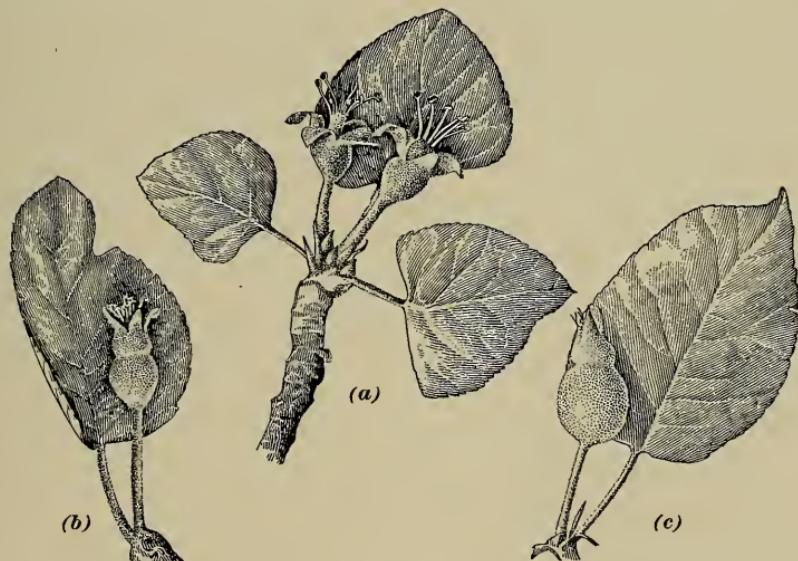


FIG. 18

As practically all the larvae of the first brood of codling moths enter the young fruit by eating through the blossom end, or calyx, of the apple, it has been found that the most effective way to kill the young larvae is to place poison in the calyx of

the young apples. As the calyx of the apple closes about 10 days after the blossoms fall, it is necessary to make the first spraying while the calyx of the young apple is open as shown in Fig. 18 (a). It is difficult, though possible, to force a spray into a calyx in the condition shown in (b), but it is too late to spray effectively for codling moth when the calyx has closed to the extent shown in (c). Sometimes the trees are treated with a spray in from 3 to 4 weeks after the blossoms fall, and with a third spraying in from 8 or 9 weeks after the blossoms fall to kill the larvae of the second brood. Therefore, to successfully combat codling moths, it is advisable that the orchardist spray the trees with an arsenical poison within a week or 10 days after the blossoms fall and again in from 2 to 3 weeks and a third time in from 4 to 5 weeks after the second spraying.

The poison most often used is arsenate of lead. About 2 pounds of the paste form or 1 pound of the powder form are used to make 50 gallons of spray. About $\frac{1}{3}$ pound of Paris green or 1 quart of stock solution of arsenite of lime may likewise be used to make 50 gallons of spray. It is a very common and commendable practice to use 50 gallons of lime-sulphur solution with a specific gravity of from 1.007 to 1.01 with which to add the poisons mentioned. A lime-sulphur solution of the strength mentioned is usually obtained by adding from $1\frac{1}{4}$ to $1\frac{1}{2}$ gallons of a standard concentrate lime-sulphur solution to 50 gallons of water. However, if the codling moth alone is to be combated, the arsenical poisons may be added to water.

31. Lesser Apple Worm.—An insect that closely resembles the codling moth is the lesser apple worm, and as the work of the two insects are strikingly similar, the same methods are used in combating them.

32. Apple Maggot.—A small, yellowish-white, footless maggot about $\frac{1}{3}$ inch long when full grown and known as the apple maggot, or the *apple railroad worm*, is shown in Fig. 19 (a). The adult form of this insect is a blackish colored fly shown in (b). It is a little smaller than the common house fly and

may be distinguished from other flies that may be seen on apples by the four rather distinct black bands across each wing and by the three or four white bands across the abdomen.

This insect causes much damage to summer and fall apples in the New England States and has been found in many other sections of the United States. The female fly deposits its eggs just beneath the skin of the apples; sometimes twelve or fifteen eggs are deposited in a single apple and from 300 to 400 eggs are deposited during a season. The young larvae, or maggots, on hatching, immediately begin eating into the apple. They burrow around through the flesh of the apple, and if several of them are present in the same apple it is likely to be eaten

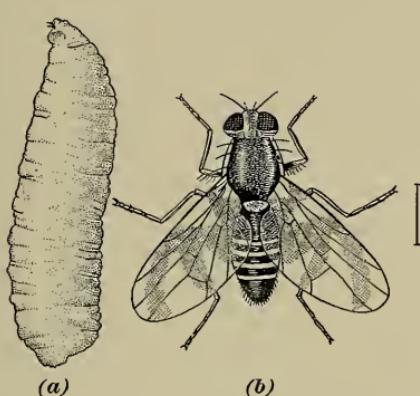


FIG. 19

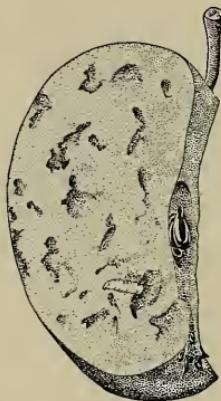


FIG. 20

full of small brownish burrows and present an appearance such as is shown in Fig. 20. The apple maggots reach full growth about the same time that the apple in which they are living ripens. Then the maggots work out of the apple, and, if in the orchard, work about 1 inch into the ground, where they pupate. If the apples are stored in a box the brownish pupas may be found in the bottom of the box.

As the apple maggot does all its eating entirely within an apple, there is no chance for the orchardist to poison this pest. However, a large part of the infested apples drop from the trees, and if these apples are gathered up and destroyed twice a week the damage of the apple maggot will not be great. If

hogs are allowed to run in the orchard they will eat the fallen apples and thus destroy the maggots.

33. Plum Curculio.—In Fig. 21 is shown the plum curculio, which often gnarls and disfigures the apple by depositing its eggs on the inside and by eating small portions from the surface of the apple. The female beetle cuts a small hole in an apple and then deposits her egg, after which she cuts a crescent-shaped wound around the puncture. The characteristic crescent-shaped wound of the plum curculio is illustrated at *a* in Fig. 22. The scar caused by the beetle eating the apple is illustrated at *b*.



FIG. 21

The insects begin depositing eggs in the apples when they are not over $\frac{1}{4}$ inch in diameter and continue until August. The eggs hatch in from 4 to 6 days and the young larvae immediately burrow in the fruit, causing it to fall within a few days. The larvae mature in about 3 weeks and crawl from the apple and pupate in the ground or under rubbish and emerge in about 4 weeks as adult insects. Many of these insects hibernate during the winter and lay eggs the following year.

In young orchards, where the trees are small, the insects may be jarred from the trees during the latter part of May and during June onto a sheet spread beneath the tree. This practice is successful only as long as the trees are small and easily jarred. Frequent sprayings with arsenical poisons reduces the injury but little. Probably the most effective method of combating the plum curculio is to keep the orchard free from weeds and to cultivate it frequently during May and June.

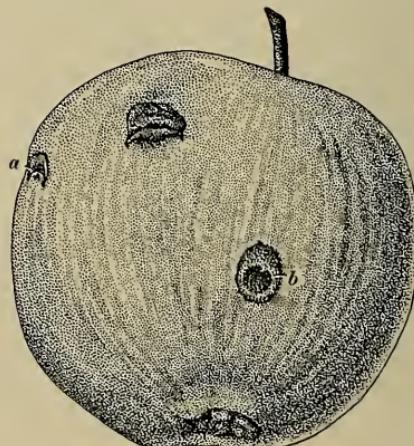


FIG. 22

34. Apple Curculio.—In Fig. 23 (a) is shown the adult form of the apple curculio and in (b) the larval form. This insect is about $\frac{1}{4}$ inch long and on the wing covers are four prominent humps. These insects lay their eggs in the apples for about 2 months after the blossoms fall. A scar on the fruit similar to that shown at a in Fig. 24 is caused by the insect depositing an egg. The mature beetle eats sparingly of the apple and the scar caused by its feeding is shown at b.

The eggs hatch within a week after being laid and the larvae develop in about 3 weeks and pupate within the apple. The mature insects emerge in about 1 week after the larvae pupate. These insects eat very sparingly of the apples, hibernate during the winter among rubbish, grass, or leaves, and deposit eggs the following year.

The methods of controlling the apple curculio are the same as those suggested for the plum curculio. However, the apple curculos eat so little of the apples that the spraying with arsenical poisons is practically useless.

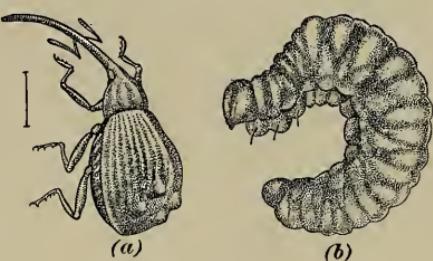


FIG. 23

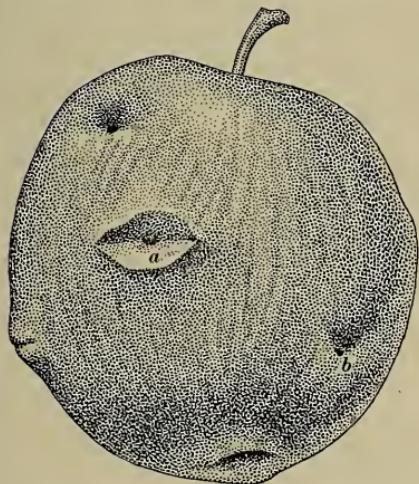


FIG. 24

(a) is of a reddish-brown color, and has two nearly parallel, oblique, light-colored bands across the front wings. These moths appear from May until July, depending on the latitude, and in from 5 to 6 weeks after apple trees blossom they deposit their eggs in clusters of from 200 to 300 eggs each. The eggs

35. Apple-Tree Tent Caterpillar.—The adult moth of the apple-tree tent caterpillar, shown in Fig. 25

are packed closely together in a grayish-brown, knot-like band around, or nearly around, a twig, as shown in (b). Each egg mass is covered with a frothy, glue-like material that gives a

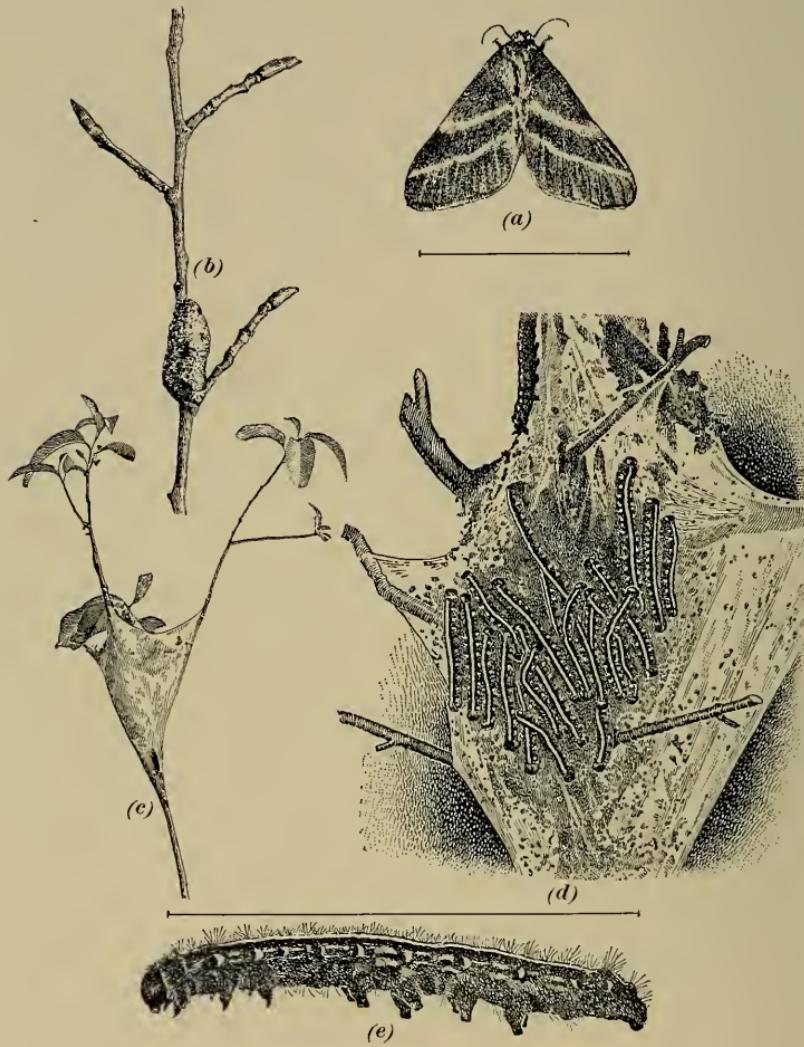


FIG. 25

glistening surface to the entire mass. These eggs remain throughout the summer and winter and hatch the next spring just about the time the leaf buds are expanding. The young larvae soon begin to feed on the opening buds and leaves, and,

working in colonies, they pass down the twigs to a fork, where they spin a silken web, or tent, as shown in (c). The caterpillars live in their silken tent during the night and stormy weather, but if the day is clear they crawl out to eat. The tent is enlarged from day to day as the caterpillars increase in size.

A tent with several one-third grown caterpillars is shown in (d). A full grown caterpillar, as shown in (e), is about 2 inches long and is black in color; it has a white stripe down its back, a pale, oval, blue spot on each side of each segment of the body, and is sparsely covered with yellowish hairs.

When full grown the caterpillar seeks some sheltered place, spins around itself a thin cocoon of tough white silk, transforms to the pupa, and in about 3 weeks emerges as a mature moth.

The apple-tree tent caterpillar may be effectively combated by spraying the trees just before they blossom with a spray containing $\frac{1}{3}$ pound of Paris green or from 2 to 3 pounds of arsenate of lead in each 50 gallons of spray solution. Or, the insects may be destroyed by applying a torch to their nests during a cloudy or cold day.

36. Fall Web Worm.—A caterpillar that is often mistaken for the apple-tree tent caterpillar is the fall web worm. This caterpillar is so named because it spins a large web over the twigs and foliage on which it feeds. The web of the fall web worm is distinguished from that of the apple-tree tent caterpillar in that the web of the latter is always woven around a fork of a small limb and does not include foliage in its meshes, and the web of the former is always spun over the leaves on which the caterpillars live, as shown in Fig. 26 (a). The mature moth, shown in (b), is from 1 to $1\frac{1}{4}$ inches across the expanded wings, is white or white with a number of black spots, and emerges late in June or in July. These moths lay eggs in clusters of from 400 to 500 eggs each on the leaves of the trees. The eggs hatch in about 10 days, and the young caterpillars begin spinning a web over the foliage on which they feed. The young caterpillars appear to be nearly all head and hair, but the full grown caterpillars, two of which are shown in (c), are about 1 inch long, somewhat woolly, and are thickly covered

with long hairs, some black and some white, that project from numerous black or black and yellowish tubercles. In color, the caterpillars vary from light yellow to almost black. They become full grown in from 4 to 6 weeks and seek a secluded spot, where they spin a cocoon in which they spend the winter in the pupal stage and emerge as mature moths in June or July. In some parts of the United States there seems to be two broods

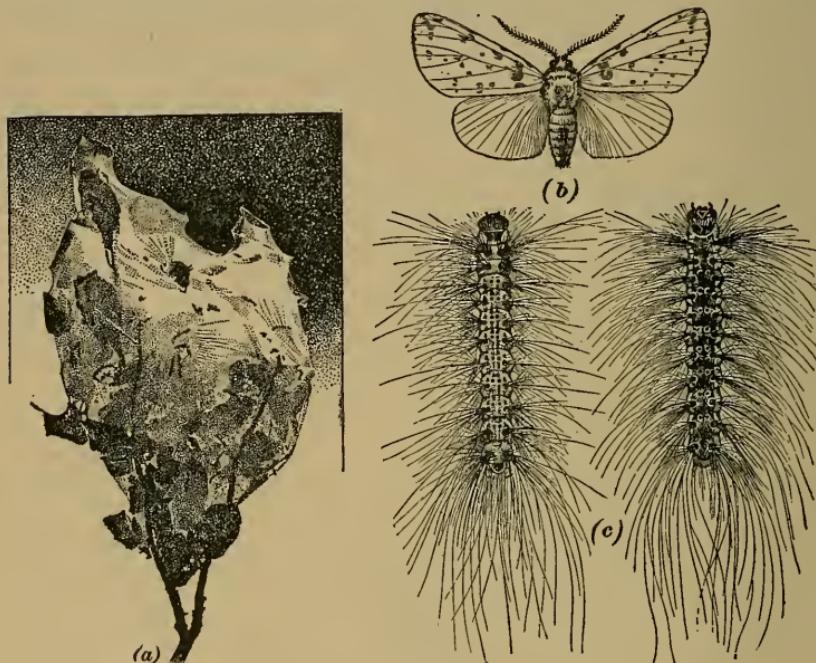


FIG. 26

of the fall web worm. The first brood of moths appears in April and May, and the second brood in August and September.

Spraying with any of the sprays recommended for the codling moth when the young caterpillars first appear will prevent the fall web worm from doing much damage. In fact, if sprays have been applied in combating the codling moth, but little trouble will develop from the fall web worm.

37. Canker Worms.—One of the most important of the leaf-eating caterpillars that attack apple trees is the canker worm. There are two species of this worm, the spring canker

worm and the fall canker worm. The female of both species is wingless, as shown in Fig. 27 (a).

The moths of the spring species emerge from the ground and crawl up the trunks of the trees. This occurs from January until May, but usually during March and April. Here they lay their eggs in irregular masses. The eggs, in about 1 month, hatch into caterpillars that are commonly known as *measuring worms* or as *loopers*. The young caterpillars at first eat holes through the leaves, but the full-grown caterpillars, one of which is shown in (b), devour the entire leaves. The caterpillars have, in addition to three pairs of true legs, one pair of prolegs, or leg-like appendages, near the rear of the body with which they hold to a twig. The caterpillars, especially the young ones,

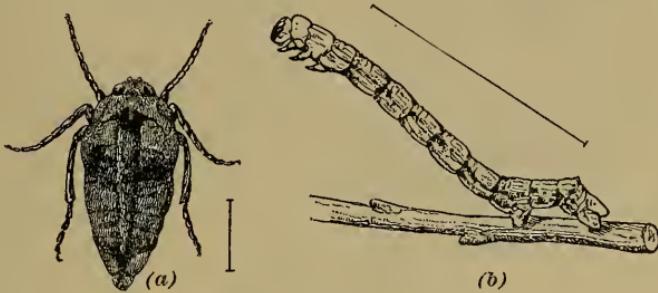


FIG. 27

have the habit of suspending themselves on fine threads of silk from trees. The caterpillars become full grown in 4 or 5 weeks and enter the soil, where they pupate and remain until they emerge the following spring as mature moths.

The fall canker worms differ from the spring species in that the mature moths emerge from September to December and lay their eggs, which do not hatch until the following spring; that the eggs are laid in clusters of about one hundred each and are deposited in straight rows; and that the caterpillars have two pairs of prolegs.

Orchards that are cultivated annually or that are sprayed annually for codling moth are seldom troubled with canker worms. Wherever canker worms are troublesome, however, they should be combated by preventing the female moths from climbing up the trees to deposit their eggs, or the caterpillars,

while they are feeding on the leaves, may be poisoned by spraying with any of the arsenical sprays that have previously been recommended for combating the codling moth. The female moths may be trapped as they crawl up the trunks of the trees by placing a band of some sticky substance, such as tanglefoot fly paper, around the trees.

38. Yellow-Necked Apple Caterpillar.—During late summer the tips of apple-tree limbs are sometimes defoliated by



FIG. 28

a cluster of yellow-necked apple caterpillars, such as shown in Fig. 28 (a). That part of the caterpillar immediately back of the jet-black head and commonly spoken of as the neck is of a

bright orange-yellow color; it is from this yellowish-colored band that the insect gets its name.

If one of these caterpillars is touched or if the limb to which it clings is jarred the insect raises its head and tail in the air and holds on to the limb by means of its abdominal prolegs. The characteristic position assumed is shown in Fig. 28 (b).

If the colonies of these caterpillars are abundant it is best to spray the trees with an arsenical poison, say 3 pounds of arsenate of lead to 50 gallons of water. If only a few colonies are to be destroyed, this can best be accomplished by swabbing the caterpillars off the limb with a rag or a handful of waste saturated with kerosene, or the tip of the limb on which the insects are clustered may be cut off and the caterpillars crushed or burned.

39. Red-Humped Apple Caterpillar.—A species of caterpillar whose habits are very similar to the yellow-necked apple caterpillar is shown in Fig. 29 and is known as the red-humped apple caterpillar. The caterpillar received its name on account of the red hump made by the fourth segment of its body. This hump and the head of the insect are of a bright coral red and makes its identification comparatively easy.

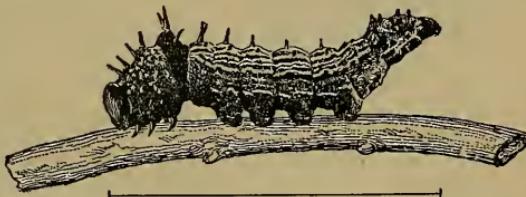


FIG. 29

The same measures are recommended in combating the red-humped apple caterpillar as for the yellow-necked apple caterpillar.

40. Brown-Tailed Moth.—In some of the New England States the brown-tailed moth is very destructive to apple orchards. The moth, which emerges during midsummer, is white except at the tip of the abdomen, which is in the form of a tuft, or brush, and has a golden-brown color. Egg masses consisting of from 300 to 400 eggs are deposited late in July, usually on the terminal leaves of the branches, and are covered with fine, brown hairs from the tip of the abdomen of the female

moth. The eggs hatch in about 3 weeks from the time they were laid and the young larvae feed on the surfaces of the leaves, but do not eat the web-like framework of the leaves. The young caterpillars soon begin to bind adjoining leaves together, and by fall have several leaves completely surrounded by a tough web and firmly fastened to a twig. This leaf nest, if viewed from a little distance, presents the appearance of a couple of dead leaves. The interior of the nest consists of from forty to sixty small pellets of silk, in each of which are wrapped from three to twelve young caterpillars. The caterpillars come out of their winter nest at the time the buds open in the spring and feed

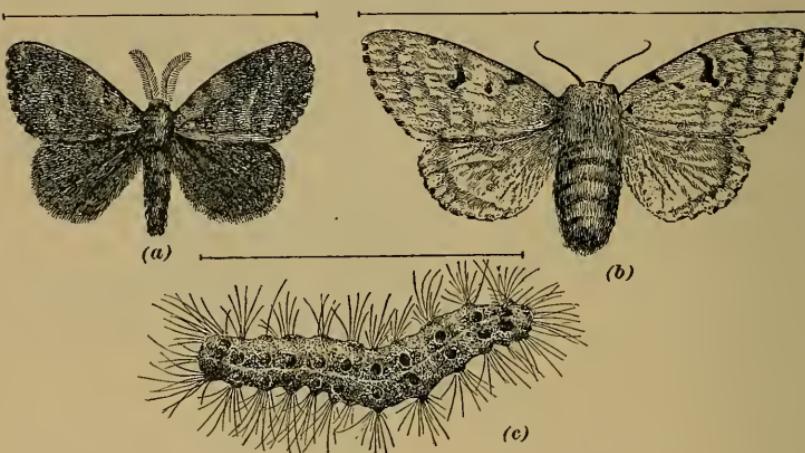


FIG. 30

on the unfolding foliage. The caterpillars mature in from 5 to 6 weeks and pupate in white silk cocoons spun among the leaves of the tree, and emerge as mature moths in about 3 weeks.

Control of the brown-tailed moth consists in pruning off and burning all winter nests and in spraying with about 4 pounds of arsenate of lead in 50 gallons of water about the time the eggs hatch.

41. Gipsy Moth.—In the United States the gipsy moth is, so far as known, confined to the New England States, but it is a serious pest and there is danger of its spread into other states.

The male moth, shown in Fig. 30 (a), is of a brownish-yellow to greenish-brown color; it is about $1\frac{1}{2}$ inches across the

spreaded wings, and flies during the day with a peculiar zigzag flight. The female moth, shown in (b), is nearly white with numerous black spots; she has a wing expanse of about 2 inches, but fortunately is unable to use her wings for flight; and, in a few days after emerging lays, on the bark of the trees, from 400 to 500 eggs in a mass covered with yellowish hairs from her body. In the following spring, about the first of May, the eggs hatch, and the caterpillars live on the foliage of the trees until about midsummer, when they pupate. The pupal stage lasts only about 10 days. The mature caterpillar, shown in

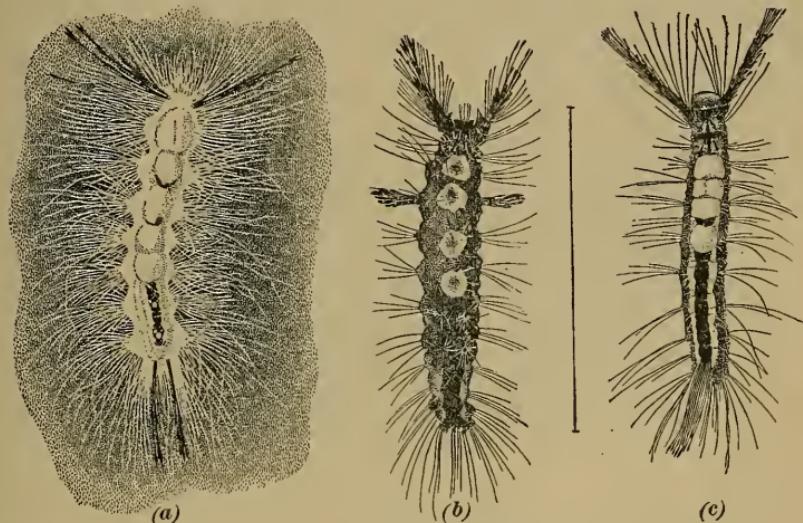


FIG. 31

(c), is of a dusty, sooty color, and has a pair of blue spots on each of the first five segments of its body and a pair of red spots on each of the next six segments. The caterpillars are readily distinguished by means of these blue and red spots.

To control the gipsy moth in the apple orchard, the egg masses should be painted in winter with creosote and the trees sprayed in the spring when the eggs are hatching with 5 pounds of arsenate of lead in 50 gallons of spray solution.

42. Tussock Moths.—The tussock moths are common pests of shade trees, and where they are abundant the caterpillars prove to be destructive of foliage on apple trees. In

Fig. 31 (a) is illustrated the mature caterpillar of the willow tussock moth; in (b) is shown the caterpillar of the rusty tussock moth, the most common and injurious of the tussock moths; and in (c) is shown the caterpillar of the white-marked tussock moth.

Tussock moths emerge from the middle to the last of June. The females are wingless and bear no resemblance to the winged male moths; in fact, the females look more like fat spiders than moths and usually lay their eggs on the cocoons from which they emerge. These eggs hatch early in July and the caterpillars mature during the late summer and pupate and emerge as mature moths during the fall. The female moths of this second brood lay eggs that remain over winter and hatch about the first of May, thus making two complete broods each year.

The destruction of egg masses during the winter months

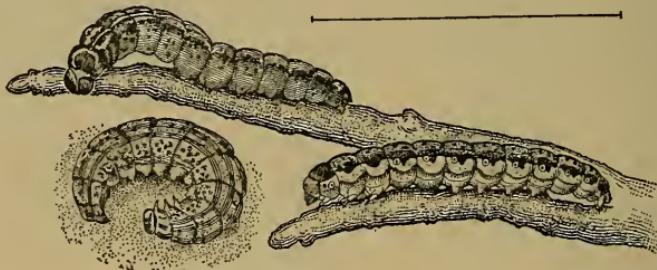


FIG. 32

and spraying as for the codling moth or for the gipsy moth will prevent serious damage from tussock moths.

43. Climbing Cutworms.—A dozen or more species of cutworms make a practice of climbing apple trees and other fruit plants at night, feeding on the opening buds and young tender foliage, and then returning to the soil, where they remain in hiding during the day. Because these insects work during the night only, the first knowledge that an orchardist may receive of their presence is that certain young trees fail to put forth leaves or that young foliage from a whole branch or of an entire tree suddenly disappears. Three of these cutworms are shown in Fig. 32. When the presence of cutworms is suspected the orchardist should visit the trees at night with a dim

light and he may be able to see the pests at work. The climbing cutworms are usually most numerous when the orchard is in sod or when the sod has been plowed under just before the planting of the trees.

To prevent attacks from cutworms, the soil in which the young trees are to be planted should be plowed late in the fall the year before the young trees are planted. When the pests are very numerous they may be poisoned by spraying the trees with almost any of the arsenical sprays that have been recommended for combating other caterpillars.

44. Bud Moth.—As the buds of apple trees begin to swell and to open they are sometimes attacked by small, dirty white



FIG. 33

caterpillars from $\frac{1}{6}$ to $\frac{1}{4}$ inch in length. These young caterpillars make a nest for themselves by spinning a fine web around the unfolding leaves, causing them to assume a crumpled condition, as shown in Fig. 33. The caterpillars attain full size, which is about $\frac{1}{2}$ inch long, during the early part of summer, when they pupate in small, silk-lined nests, from which the moths emerge in about 10 days. The moths

soon lay their eggs, which hatch in a few days and the young caterpillars feed on the under side of leaves until fall, when they spin on the twigs small silken cases in which they spend the winter; they finish their growth in the following spring.

A solution of 5 pounds of arsenate of lead and 50 gallons of water sprayed on the trees just as the buds are bursting and again just before the trees blossom will destroy the caterpillars of the bud moth.

45. Pistol Case Bearer.—An interesting little caterpillar that, in some sections, is a destructive pest in apple orchards, is shown enlarged several times in Fig. 34 (a); in (b)



FIG. 34

are shown several of the peculiar pistol-shaped cases in which the caterpillars live and in which they move from place to place on the twigs and leaves. The partly grown caterpillars are about $\frac{1}{8}$ of an inch long; they hibernate during the winter and early in the spring feed on the unopened buds and young leaves, but later devour the entire leaves except the large veins and the midribs. The caterpillars become full grown, or about $\frac{1}{2}$ inch long, during early summer, when they attach their silken cases to twigs and pupate. In about 10 days the moths emerge

and lay their eggs on the under surfaces of the leaves. The eggs hatch within a few days and the very young caterpillars at first eat the tissue between the surfaces of the leaves.

The pistol case bearer can be effectively controlled by spraying with an arsenical poison just before the buds open and again as soon as the leaves are out.

46. Cigar Case Bearer.—In Fig. 35 (a) is shown the caterpillar of the cigar case bearer, an insect whose habits and



FIG. 35

life history are practically the same as those of the pistol case bearer. The cigar case bearer has received its name on account of the resemblance of its covering case to that of a very small cigar. In (b) is shown the effects of the cigar case bearers and also several of the cases on the partly eaten leaves. Cigar case bearers are controlled by the same methods as the pistol case bearer.

47. Fruit-Tree Leaf Roller.—An insect that sometimes causes a very great loss to the apple crop in some parts of the United States is the fruit-tree leaf roller. The moths emerge, usually during June, and lay their eggs in a mass on a twig or small limb and completely cover the eggs with a gummy-like, brown substance that protects them from the weather. These egg masses remain on the trees until the latter part of the following spring, when they hatch. An egg mass in which a part of the eggs have hatched and the young caterpillars have eaten out through the gummy covering is shown in Fig. 36 (a). The

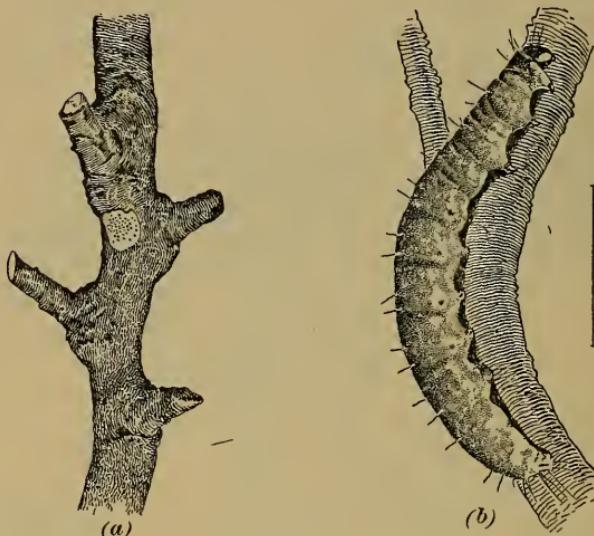


FIG. 36

caterpillars, one of which is shown in (b), are of a light straw color, with the head and first segment of the body sometimes almost black. The young caterpillars spin a few fine silk threads around a few leaves, drawing them into more or less of a loose cluster inside of which the young pests feed. As soon as the fruit has set, a caterpillar draws a few leaves around an apple and then feeds on the apple. It is by eating the young apples that the caterpillars cause the greatest loss.

The fruit-tree leaf roller can be successfully combated by spraying the trees with a solution made by adding 4 pounds of arsenate of lead to 50 gallons of water.

48. Apple Leaf Miner.—A very small caterpillar, known as the apple leaf miner, has occasionally caused considerable damage to apple orchards in certain parts of the United States. A small moth about $\frac{1}{3}$ inch across its expanded wings deposits its eggs on the under side of apple leaves during April and May. The eggs hatch in about 10 days and the young caterpillars eat their way from the eggs directly into the leaves, where they live by eating small trumpet-shaped mines between the upper and lower surfaces of the leaves. An apple leaf, showing the characteristic mines of the apple leaf miner, is illustrated in Fig. 37. The caterpillars become full grown, or about $\frac{1}{3}$ inch long, in about 3 weeks, when they pupate within the leaf. There are usually two and sometimes four or five generations a year.

The caterpillars of the last brood pass the winter in the leaves, and because of this fact the most effective way to destroy the apple leaf miners is to collect and burn all apple leaves in the fall or to plow them under.

49. Apple-Tree Bucculatrix.—The larva, or caterpillar, of the tiny moth known as the apple-tree bucculatrix sometimes does considerable damage to apple trees by mining, or eating, practically all the tissue of the leaves except the upper surface. The caterpillars are scarcely ever more than $\frac{1}{4}$ inch long, but when they occur in large numbers the white cocoons, which are about $\frac{1}{2}$ inch long and in which the caterpillars pupate, almost cover the twigs. There are usually two broods a year; the caterpillars of the second brood remain on the tree all winter in the little white cocoons.



FIG. 37

Spraying the trees during the winter with a lime-sulphur solution of a specific gravity of 1.03 will kill the hibernating pupas, and the arsenate-of-lead spray recommended for the codling moth will kill the caterpillars as they are eating the leaves.

50. Palmer Worm.—An insect that makes very irregular appearances in apple orchards is the palmer worm. These so-called worms, which, when full grown are about $\frac{1}{2}$ inch long, are the caterpillars of small ashen colored moths. The caterpillars vary in color from flesh to yellow, are tinted with green, and are sparsely covered with fine hairs. They appear in large numbers and at long intervals; sometimes as many as 50 years elapse between their appearances. They eat all the soft tissue of the leaves.

When use is made of an arsenical spray as in combating the codling moth, little damage to an apple orchard will follow the appearance of the palmer worms.

51. Brown Mite.—The presence of brown mites, also known as *clover mites*, in an apple orchard is indicated by a sickly, faded appearance of the leaves. Although the mites feed on the leaves, they deposit their eggs on the twigs and limbs, and if the mites are particularly abundant their eggs often cause the twigs to present a red color, especially during the winter.

Probably the best method of combating brown mites is to spray the trees during winter with lime-sulphur, of a specific gravity of 1.03, which will destroy the mite eggs.

52. Woolly Apple Aphis.—A very serious insect to young apple trees and apple trees in an unthrifty condition is a small plant louse known as the woolly apple aphis. The name woolly aphis was, no doubt, given to this insect from the fact that a bluish-white, cottony, waxy mass is secreted in threads from the abdomen of the insect. This cottony, or wool-like, secretion gives a colony of the insects a bluish-white, or mold-like, appearance. The life history of this insect is peculiar in many respects, and an understanding of its life enables orchardists better to combat the insect. The colonies are largely composed of

mature, wingless females, one of which is illustrated in Fig. 38 (a). This form of the insect appears throughout the summer months and produces from two to twenty young wingless females each day; these mature in from 8 to 20 days and begin giving birth to young. In the fall, the wingless females produce a brood of winged females, one of which is shown in (b). These winged

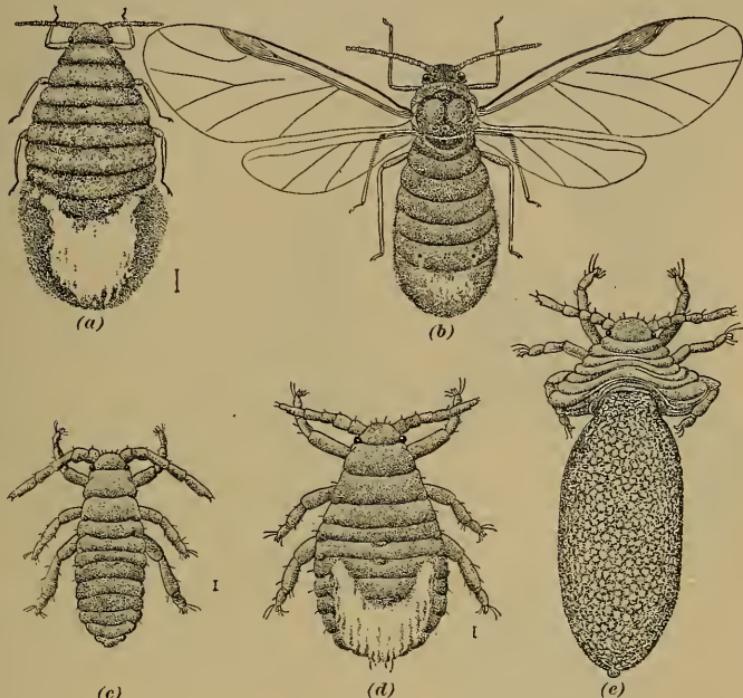


FIG. 38

females migrate to other trees and give birth to from four to six wingless males and females. The sexual male insect is shown in (c) and the sexual female insect in (d).

The mouth parts of the sexual forms are very poorly developed, and neither the male nor the female takes any food. They mate, however, and the female lays a single large black egg, which is usually deposited under a loose piece of bark somewhere on the lower part of the trunk of the tree. The female with the large egg extruded, but still attached to her body is shown greatly enlarged in (e). This egg hatches in the

early spring into a wingless female like that shown in (a), thus completing the life cycle of the insect.

The woolly apple aphid lives both on the limbs and on the roots of apple trees. It is most often found on young green twigs of the trees such as water sprouts and on the leaves and in wounds. A colony of these insects is shown in Fig. 39 (a) on a twig and in a wound in the bark of a small apple tree. Whenever these insects are found on the trunk and limbs of a tree, they are almost sure to be on the roots also, and it is

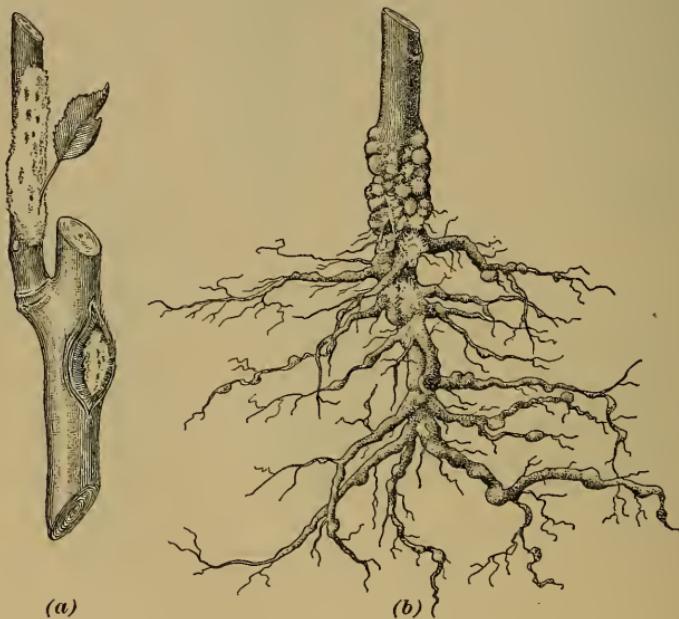


FIG. 39

on the roots that the most damage is done. Roots of young apple trees infested with the woolly apple aphid develop knot-like galls, and if not relieved from the sucking of the insects, the roots will eventually die. As soon as a root dies the insects move to a fresh root, so that the absence of the insects on a badly galled root does not indicate that the insects have left the tree, but that they have simply moved to some other root. The galls, or knots, caused by the woolly apple aphid are shown in (b).

53. The insects on the twigs and foliage can be destroyed by spraying with a 7-per-cent. solution of kerosene emulsion, that is, a mixture of 1 gallon of the kerosene emulsion and about 13 gallons of water; with miscible oil diluted from 30 to 40 times; with tobacco extract or decoction, diluted according to the directions on the package; or with a solution of 1 pound of whale-oil soap and 6 gallons of water. A winter spray of lime-sulphur of a specific gravity of 1.03 is effective in destroying any hibernating insects and the eggs.

The insects on the roots of trees are not so easily killed as those on the twigs and foliage. It is recommended that the earth for a depth of from 4 to 5 inches and for a radius of about 2 feet around each tree be removed and from 1 to 5 pounds of tobacco dust, from 2 to 3 gallons of a 10-per-cent. kerosene emulsion, or a dilute tobacco extract be sprinkled over the area from which the earth was removed. The earth should then be replaced.

54. Green Apple Aphis.

In Fig. 40 is illustrated an apple twig that shows the characteristic effect of the common green apple aphid, or *green apple louse*. Enlarged, is shown in Fig. 41 (a), and a colony is shown on the under side of a leaf in (b). The insects feed usually on the under surface of the leaves, causing them to curl and crinkle and finally to drop off, but the insects also attack the tender tips of growing shoots, especially grafts and water sprouts. The injury

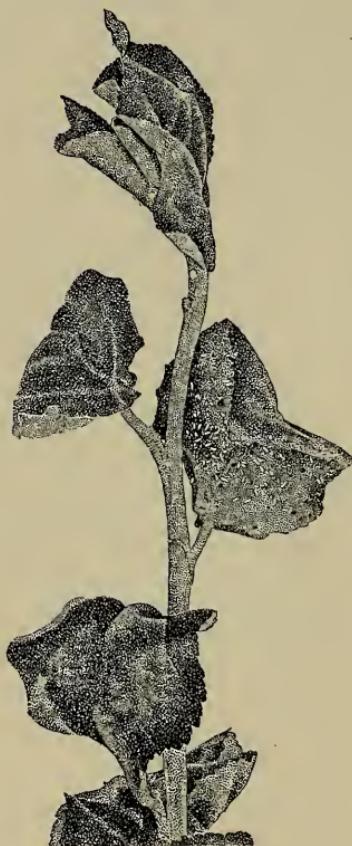


FIG. 40

One of these insects, much enlarged, is shown in Fig. 41 (a), and a colony is shown on the under side of a leaf in (b). The insects feed usually on the under surface of the leaves, causing them to curl and crinkle and finally to drop off, but the insects also attack the tender tips of growing shoots, especially grafts and water sprouts. The injury

caused by the insects is mostly confined to young trees, but where they are excessively abundant the foliage of old trees and the young fruit may be injured. The latter will become stunted and misshapen.

The first brood of the green apple aphid appears just before the leaf buds open. This brood is hatched from eggs that were laid the previous fall on the twigs, especially in forks, around the buds, and leaf scars. All the insects of this first brood are wingless females. They develop and give birth in about 6 weeks to the second generation of females, which are generally wingless. Each female gives birth to from fifty to one hundred young. The insects of the third generation, which appear in about 6 weeks after the second generation, usually develop

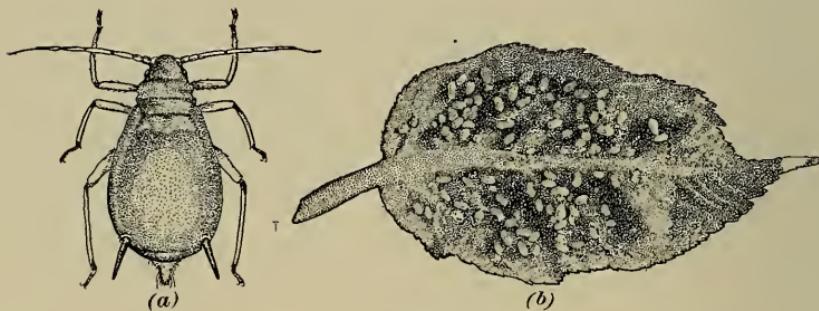


FIG. 41

wings and migrate to other trees in the immediate vicinity. All the insects that are born during the summer are females, but as soon as cool weather approaches in autumn, both males and females are born, and the females lay the eggs from which the first brood is hatched in the spring. During the late fall all the insects are killed by cold.

The same methods of control are applicable for the green apple aphid as for the woolly apple aphid above the surface of the soil.

55. Miscellaneous Aphides Affecting Apple Trees. Besides the woolly and the green apple aphid, which are especially apple-tree pests, there are several species of aphides that at times prove injurious to apple trees. Among these occasionally injurious pests are the *rosy apple aphid*, the *European*

grain aphis, and the *clover aphis*. In respect to their effect on apple trees, these insects resemble very much the green apple aphis, but they vary in respect to color and character. The methods of combating them are the same as those recommended for the woolly apple aphis.

56. Leaf-Blister Mite.—Within recent years a microscopic mite known as the leaf-blister mite has attacked apple foliage. Leaf-blister mites, which are not more than $\frac{1}{100}$ inch

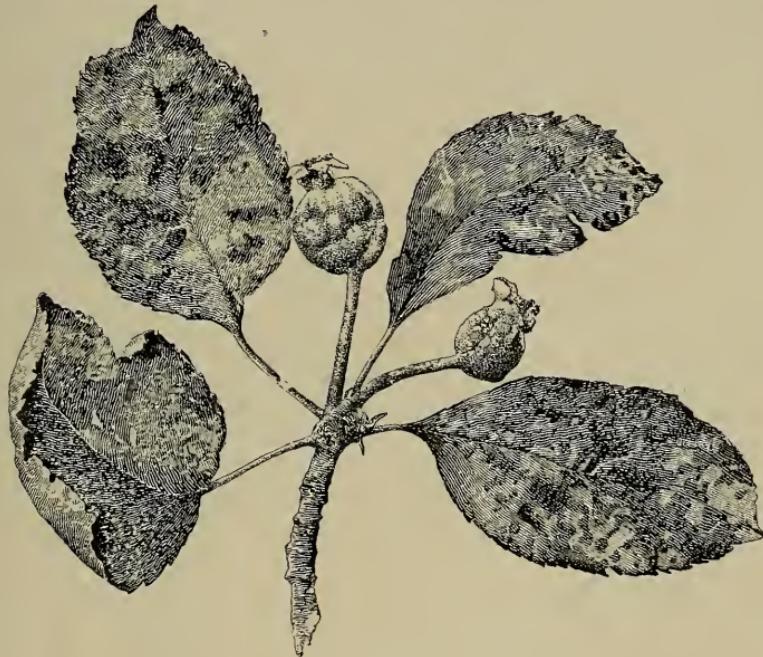


FIG. 42

in length, pass the winter in the buds, but on the arrival of warm weather they emerge and as the leaves unfold the mites burrow into them and feed on the tender tissue. Although the mites are too small to be easily seen by the unaided eye, their presence in the leaves is readily recognized by the reddish blisters that form on the young leaves. These blisters later turn almost black and present a corky appearance. If the mites are especially numerous, a large number of the leaves may fall and the mites will attack the young apples. An apple twig on which

both the leaves and fruit are infested by the leaf-blister mite is shown in Fig. 42.

Leaf-blister mites are kept under control by spraying as soon as most of the leaves have fallen in the autumn or just as the leaf buds begin to swell in the spring, with a 10-per-cent. kerosene emulsion, with miscible oil, or with lime-sulphur used the same as in combating San José scale. If an infestation of the mites is very serious, both the fall and the spring spraying are recommended; ordinarily, either spraying will be sufficient.

57. Buffalo Treehopper.—The curious-looking insect illustrated in Fig. 43 (a) and known as the buffalo treehopper

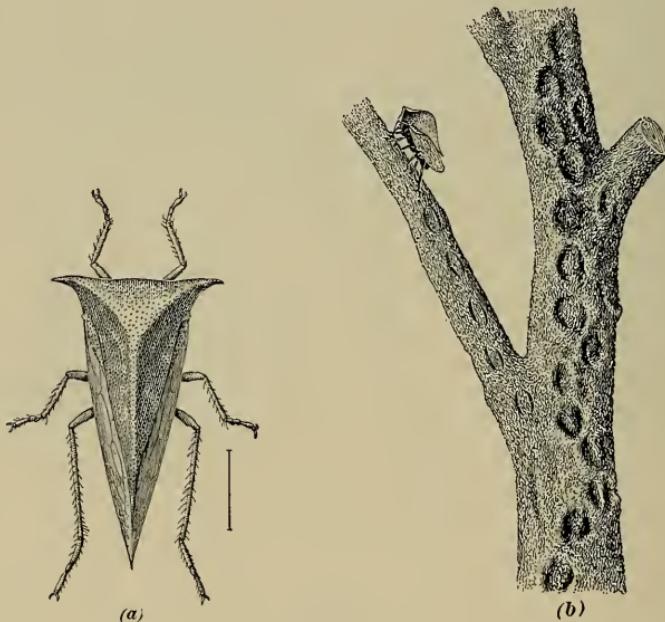


FIG. 43

is often the cause of considerable damage to small limbs of the apple tree. It is green in color and about $\frac{3}{8}$ inch long. Buffalo treehoppers damage the small limbs of apple trees by depositing their eggs in two characteristic, curved wounds in the limbs from early in August until killing frost occurs. From six to twelve eggs are placed in each slit, or wound, and each female insect may make several of the double wounds. The bark

between the curved slits is cut entirely loose when the eggs are deposited and soon dies. If the wounds are numerous, as is shown on the twig illustrated in (b), the twig is necessarily badly stunted and may die. The eggs hatch during May and June, and the nymphs, or young insects, feed on all kinds of succulent vegetation. The orchards that suffer worst from the egg-laying injuries of these little pests are those that are grown up in weeds.

To prevent the buffalo treehopper from causing any considerable damage to an orchard, all weeds should be kept cut down and trees that are badly injured by the insects should be well pruned and the limbs that are removed should be burned.

58. Periodical Cicada.—In Fig. 44 (a) is shown the mature periodical cicada, commonly known as the *seventeen-year locust*. In (b) is illustrated the skin cast by the full grown

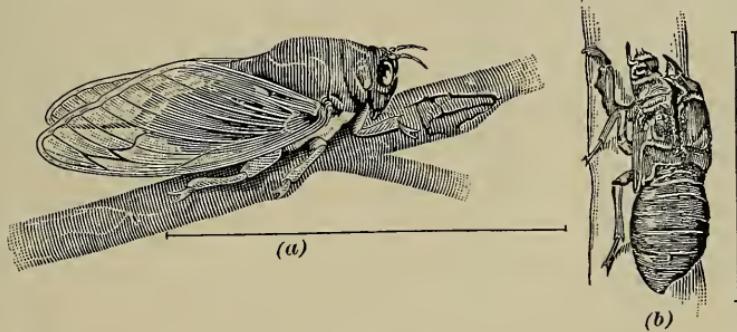


FIG. 44

nymph. Large numbers of the adults appear during May and June of every seventeenth year, although a few may appear during the sixteenth year, when large numbers of the nymphs may be found near the surface of the ground. In about 3 weeks after the appearance of these insects the females begin depositing their eggs in the trunks of small trees and in the small limbs and twigs of large trees. The female makes a wound in the wood in which she deposits several eggs; it is claimed that each one deposits from 300 to 500 eggs. The damage done to an orchard by these insects is caused by these wounds. The

effects of such wounds are shown in Fig. 45. On small branches the wound causes the branch to die from the point of the wound to the tip, and on large limbs the scars caused by the wounds are points of attack for borers and the wooly apple aphid.

The adult cicadas do not eat but suck the juices of plants. It is, therefore, impossible to poison them. Many of the

mature nymphs of the cicadas will be destroyed during April and May of the year that they are known to be due to appear, if hogs are allowed to run on land that is known to be infested by the cicadas. Young orchards should not be planted during the year or two just previous to the year that cicadas are to emerge in that vicinity; neither should budding, grafting, or pruning be practiced the year before they are to emerge. In July all twigs in which cicada eggs have been deposited should be pruned off and burned.



FIG. 45

59. Fruit-Tree Bark Beetle. In Fig. 46 (a) is shown, magnified many times, a little black beetle about $\frac{1}{3}$ inch long known as the fruit-tree bark beetle and also as the *shot-hole borer*. The latter name has been given to the insect from

the fact that the larva, which is

shown in (b), riddles the bark of infested branches with small holes, such as are shown in the upper part of (c). The lower part of (c) shows the galleries of the fruit-tree bark beetle as they appear under the bark of an infested apple twig. Three or four generations of these insects probably occur each year.

In combating the fruit-tree bark beetle, it is recommended that all badly infested branches and even small trees that are

badly infested should be cut out and burned. The trees should be cultivated and placed in a healthful, growing condition, because the insects attack injured, dying, or dead trees.

60. Apple-Tree Pruner.—A long-horned, brownish beetle varying in length from $\frac{1}{2}$ to $\frac{3}{4}$ inch appears during June or July and deposits its eggs in small twigs. The larva, upon hatching, works its way down the small twig until it reaches a larger branch, from which it gnaws away so much wood that the first wind breaks off the twig. The larva then completes its development in the severed twig.

This insect is comparatively easy to keep in control by simply gathering all broken twigs that may be found in the orchard during the autumn and burning them.

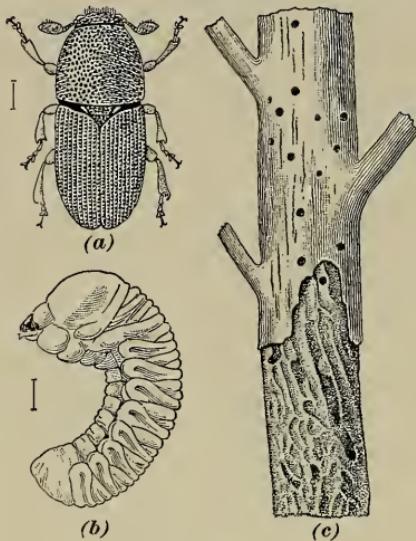


FIG. 46

APPLE DISEASES

61. There are a number of diseases common to apples in most sections that are very serious, and a larger number that are less serious and are controlled by the same treatments that control the most important diseases. In sections where apple growing is a comparatively new industry, apple orchards may be reasonably free from diseases, but in most sections where the climate is suitable the diseases are likely to be introduced before apple growing has been carried on very long. Therefore, to grow apples successfully, the orchardist must learn to combat the diseases that attack the apple tree and its fruit.

The effect of disease cannot be remedied; that is, the leaves or fruit cannot be cured of disease after it has become established in the fruit or leaves. The only possible method of combating disease is by preventive measures; that is, by measures to prevent the growth on the fruit or leaves of the organisms that cause disease.

The most important preventive measure is spraying with some substance that is sufficiently toxic to fungus or bacteria to prevent their growth and yet not seriously injure the foliage or fruit. The only other available method of fighting disease is by destroying injured parts so that there will be no source of infection.

62. Bitter Rot.—The most destructive apple disease in the leading apple-growing districts is claimed by many authorities to be bitter rot, also known as *ripe rot*, and as *apple*

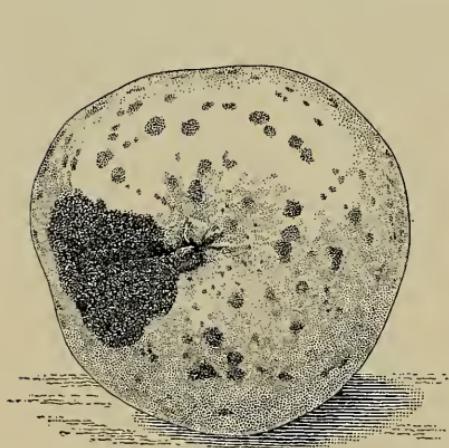


FIG. 47

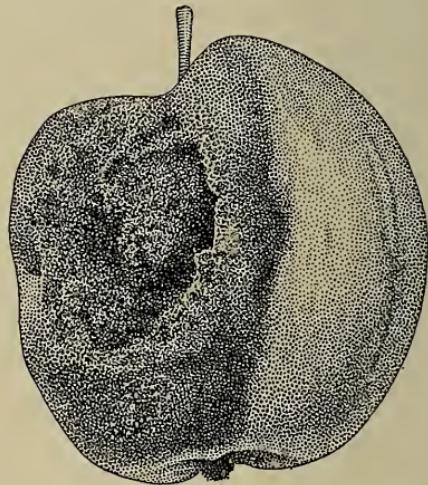


FIG. 48

anthracnose. The first two names are somewhat misleading, as the disease does not always cause the affected apple to become bitter, nor does the disease attack ripe fruit only; twigs and limbs are sometimes affected.

The early stages of the disease are shown by small brown spots in the tissue of the apple just beneath the skin. As the disease advances these spots become larger and appear

on the surface of the apple as soft, usually wet, brown, tan, or black, circular, rotten spots. As soon as the spots have attained a size of about $\frac{1}{4}$ inch in diameter the center portion of the circle is sunken and the rotten part develops rapidly. That part of the fruit near the rotten spot is usually bitter, and it is this character that has caused the disease to be named bitter rot. The early stage of bitter rot is shown in Fig. 47. As the rotten spots increase in size, their surfaces become somewhat shriveled and wrinkled, as shown in Fig. 48, and near the center of the affected area appear very small spore-bearing pustules barely visible to the eyes without the use of a magnifying glass.

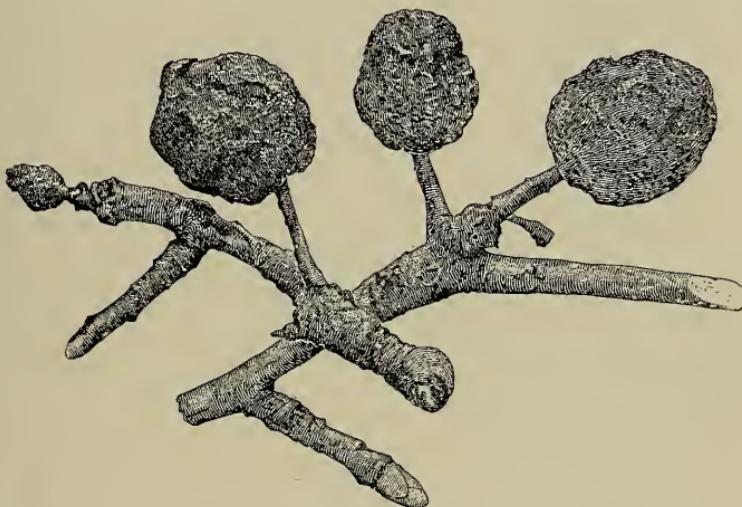


FIG. 49

Diseased apples usually fall from the tree, but sometimes an apple affected by bitter rot may remain on the tree and become dried and wrinkled, as that shown in Fig. 49. These dried and wrinkled apples are sometimes known as *mummies*.

Bitter rot also attacks twigs and young branches, causing cankers, or rough spots, on the bark, as is shown in Fig. 50.

The first stages of bitter rot usually appear during July and August, but under exceptionally favorable conditions, such as sultry, warm, rainy weather, and in the southern part of the apple-growing section the disease may appear much earlier. During warm, sultry, rainy seasons bitter rot may

spread very rapidly and cause great loss of apples within a week. It has been estimated by persons who have made a careful study of the loss caused by bitter rot that some years this disease alone causes a loss of \$10,000,000 to the apple growers of the United States.

To keep bitter rot under control in an apple orchard, the orchardist should pick and destroy all diseased apples and cut out and burn all cankered limbs. In addition to these precautions, it is recommended that the orchard be sprayed with

4-6-50 Bordeaux mixture, as lime-sulphur fails to control it. In sections where the disease is well established, the first application should be made about 6 weeks after the blossoms fall; a second application should follow within 2 weeks if the disease is serious, or within 3 weeks if it is only slight. Two more applications at intervals of 2 or 3 weeks are necessary in sections where the disease is very serious.

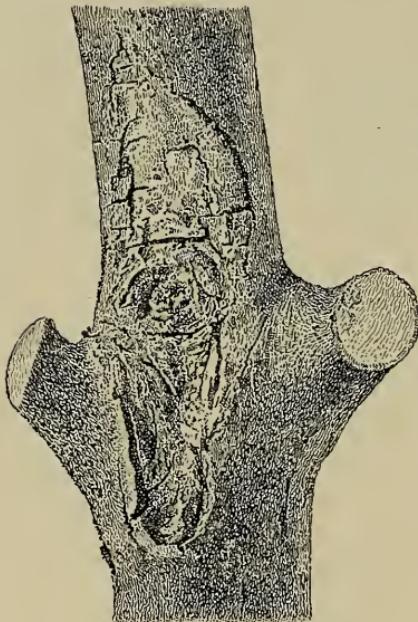


FIG. 50

scab. It is more serious in a wet climate than in a dry one, and, as it is favored by cool weather, it is more serious in the northern part of the apple-growing section than in the southern part, although successful orchardists find it necessary to combat apple scab in all apple-growing regions.

Apple scab is well described by its name. It is seen as scabby dark spots on the foliage and fruit. The newly infected areas on leaves are usually circular in form and have a greenish or light surface, but when older they turn black. Leaves

63. Apple Scab.—The most widely distributed and one of the most damaging diseases of the apple is apple

infected with scab are shown in Fig. 51. Badly infected leaves become distorted and finally may fall off. Spots on the fruit are also circular in form and similar in color to those on the leaves. The infected areas usually begin as small spots and as they enlarge they unite and form large, dark, irregular areas, which stop the growth of the apple at the point of infection and may very seriously distort the shape of the fruit. Several badly infested apples are shown in Fig. 52. Varieties of



FIG. 51

apples vary greatly in their susceptibility to attacks of scab; some varieties are almost free from it and other varieties are very readily susceptible.

The scab lives through the winter on the fallen leaves and spreads from them to the young leaves in spring. Usually the worst infection will be on the lower branches in very early spring.

This disease can be controlled by the use of either Bordeaux mixture or lime-sulphur; in fact, it is one of the most easily controlled diseases. The trees should be sprayed, just before



FIG. 52



FIG. 53



FIG. 54

the blossoms open, with a Bordeaux mixture of a strength of 4-4-50, and again just after the blossoms fall with lime-sulphur of a specific gravity of from 1.007 to 1.01, or with a 2-3-50 Bordeaux mixture. In some sections where scab is very prevalent it may be necessary to spray again within 2 or 3 weeks, using either the weak Bordeaux mixture or the weak lime-sulphur.

64. Pink Rot.—Apples that are infested with apple scab are very likely to be infested during autumn, especially if the weather is wet and muggy, with a mold that grows on the scabby spots; at first it is white, but later turns pink. The skin around and the flesh under the pink mold turns brown and bitter. The brown spots increase in size rapidly and the market value of the apples is soon destroyed. An apple badly infested with pink rot is shown in Fig. 53.

Pink rot follows apple scab and by successfully spraying for apple scab the orchardist will have no losses from pink rot of apples in the fall after the apples are harvested.

65. Apple Blotch.—A disease that is common in the southern part of the apple-growing region and that resembles apple scab in its effect on the fruit, leaves, and twigs is apple blotch. The first evidence of this disease on the fruit is a very small, inconspicuous, light-brown, somewhat star-shaped blotch. The blotch spreads radially until it attains a diameter of from $\frac{1}{8}$ to $\frac{1}{2}$ inch, and becomes darker in color. The margin of these patches always has a broken appearance. Sometimes the spots are so numerous that they join together and form large blotches, which may cover one-half or more of the apple. This disease sometimes causes the surface of infested apples to crack. These cracks, or cankers, often intersect, forming crosses. Several apples infested with apple blotch are shown in Fig. 54. Apple blotch appears on the leaves as very small, irregular-shaped, light-brown or yellow spots, very much smaller than those of the apple scab. On the twigs, especially on the fruit spurs and rapidly growing shoots, small cankers are produced that often show cracks in the dead bark as shown in Fig. 55. These cankers are generally small, being about $\frac{1}{8}$ inch wide and $\frac{1}{2}$ inch or more long.

At first they appear as very small purplish-black blotches, but as they increase in size they become brown in the center and retain a purplish margin, although they may finally become gray.

Apple blotch apparently lives through the winter on the twigs



FIG. 55



FIG. 56

and it is from them that infection of the leaves and fruit takes place in the spring, about 4 or 6 weeks after the blossoms fall.

The only remedy that has been found to control apple blotch is spraying with Bordeaux mixture; lime-sulphur has, so far as known, failed to control it. The first spraying should be given 3 or 4 weeks after the blossoms fall, so that the Bordeaux

will be on the leaves and fruit at the time the infection usually takes place, and in sections where the disease is common it may be necessary to apply two or three more sprayings at intervals of 3 weeks. The Bordeaux mixture should be used at a strength of 4-4-50.

66. Black Rot.—A disease that causes reddish-brown spots to occur on apple leaves early in the spring is known as black rot. This disease resembles bitter rot in that both diseases attack the foliage, the fruit, and the limbs. Black rot probably causes the greatest injury to large limbs, on which it causes rough, black, wounded areas, or cankers, such as the one shown in Fig. 56. The bark on the cankered part of a limb is usually dead and the new bark and the wood growing around the dead part produces a sunken area that is characteristic of the disease. In badly infected orchards the cankers sometimes surround, or girdle, a limb and thus kill it.

At first, black rot shows on apples as small reddish-brown spots, but as the spots increase in size the entire fruit becomes infected and assumes a very dark-brown or black color. Badly infected apples sometimes shrivel, but they do not take on the characteristic shriveled, wrinkled, mummified appearance of apples infected with bitter rot.

The fungus that causes black rot also attacks the leaves and causes the disease known as *leaf spot* and as *frog eye*. The spots on the leaves caused by black rot are at first very small purplish spots, which, as they enlarge, become reddish-brown and finally a grayish color. During the early part of the summer the spots are circular, but during the latter part of the summer the spots may enlarge and become irregular in shape.

The same treatment is recommended for black rot as for bitter rot.

67. Pacific-Coast Canker.—A disease that causes much loss in apple orchards in the northwestern part of the United States and in British Columbia is known as Pacific-coast canker and as *black-spot canker*. This disease infects the bark and sap wood of the twigs and branches of trees and also the fruit after it has been placed in storage.

The cankers on the twigs and limbs are similar in general appearance to bitter-rot canker, although the Pacific-coast canker is somewhat more round, and, when old, the dead, diseased part is separated from the healthy part by a distinct fissure and may finally fall out, leaving the wood exposed.

Pacific-coast canker first appears on the fruit as small, light-brown, circular, rotten spots, which later turn very dark brown or black and become tough, wrinkled, and dry, with concentric circles of spore-bearing pustules. An apple partly rotted by this disease is shown in Fig. 57.

68. Miscellaneous Cankers.—Several different kinds of cankers are reported and described by various plant pathologists,

but, because of the fact that the twigs and branches infected by these cankers are so similar to those that are shown in Figs. 50, 55, and 56 that a microscopic examination of the fungus causing each disease is necessary for a determination of the particular disease, and because practically all canker diseases are treated the same way, even a brief descrip-

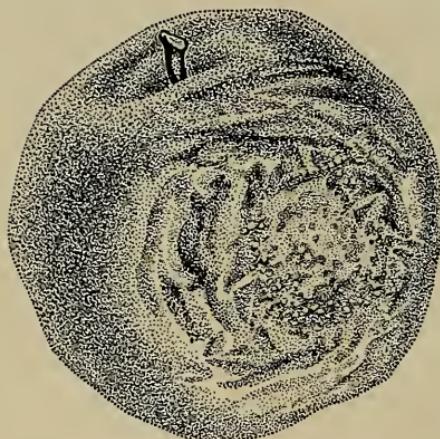


FIG. 57

tion of several cankers, including the *Illinois canker*, the *European canker*, and the *bark canker*, are not presented in this Section.

69. Soft Rot.—The rot of apples near the end of their keeping season is known as soft rot, also as *bin rot* and as *blue mold*. The trouble is known as soft rot, because the light tan-colored rotten part of the apple is soft and watery; as bin rot, because this rot does not usually attack apples until they are stored, usually in bins; as blue mold, because over all cracks in a decaying apple appear a very short fur-like growth of fungus. This fungous growth is white at first, but soon changes to a bluish green. The spores of this mold cannot force their

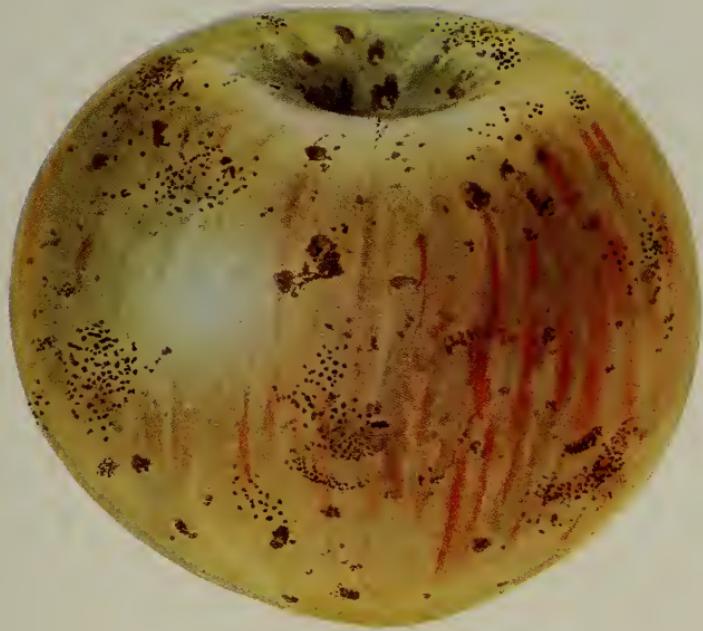


FIG. 58

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way through the healthy skin of an apple, therefore, the best means of controlling soft rot is care to prevent bruising or breaking the skin of the apples.

70. Fly Speck and Sooty Blotch.—The disease illustrated in Fig. 58 is known as fly speck, as sooty blotch, and also as *cloud*. Although the disease is commonly spoken of as two distinct diseases, authorities are generally agreed that both conditions, that is, the small black specks that closely resemble fly specks and arranged in clusters and the black soot-like blotches, are caused by the same fungus. However, some apples may show only the sooty blotches and other apples only the fly-speck spots. Both the small specks and the blotches appear about the time that the apples begin to mature and the specks or the blotches develop more rapidly during moist weather and in orchards with dense foliage than during dry weather or in an orchard where the trees are open headed and well pruned.

The market value of apples that are badly discolored by fly speck or sooty blotch is often materially reduced. The disease is easily controlled by the sprays recommended for bitter rot.

71. Apple Rust.—Orchards in the vicinity of cedar trees are subject to a disease known as apple rust, also as *cedar rust*.

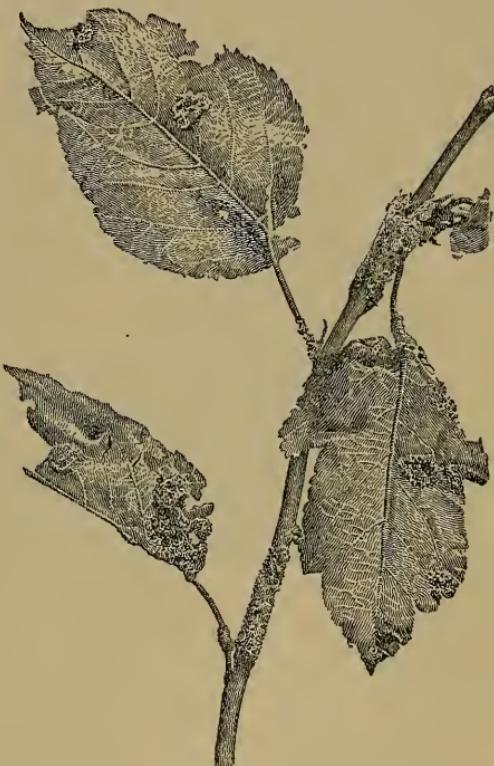


FIG. 59

and as *rust*. This disease is usually easily recognized by the yellowish orange-colored spots on the leaves. Although the spots occur also on the fruit and the twigs, the spots on the leaves are by far more common and more noticeable than are those on the fruit or the twigs. The appearance of this disease on infected leaves and twigs is shown in Fig. 59. The effect of the disease on the fruit is shown in Fig. 60. The fungus that causes this disease spends the winter on cedar trees, producing on them growths, or knots, known as *cedar apples*. In Fig. 61 are shown cedar apples in three stages of maturity. In (a) is shown a cedar apple as it appears during early winter; during the spring these cedar apples or gall-like growths appear as shown in (b); and in (c) is shown the large gelatinous growth

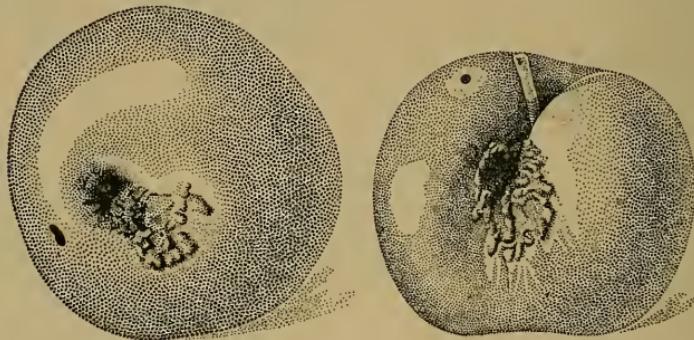


FIG. 60

expanded by spring rains. From this latter form are produced the spores that cause the rust on the apple leaves, twigs, and fruit during the summer.

If rust is injurious to orchards, all cedar trees in the vicinity of the orchard should be destroyed. If this is impracticable, it is recommended that the orchard be sprayed with Bordeaux mixture as is recommended for apple scab.

72. Fruit Spot of Apples.—A disease that sometimes attacks apples grown in the eastern half of the United States is known as the fruit spot of apples. This disease appears from the first to the middle of August as small spots on the surface of the apples. On red apples the spots are of a deeper red than the rest of the apple and on light or green apples the spots are

of a darker green color. As the fruit ripens the spots appear more prominent and on red apples, such as the Baldwins, which are especially susceptible to the disease, often become brown or black. Also the flesh just beneath the spots on the skin



FIG. 61

becomes brown and corky. The effects of this disease are confined to the skin and to the tissue immediately beneath it.

The same treatment that is recommended for apple scab will effectively control fruit spot of apples. However, if only the latter disease is to be combated the sprays may be applied about 1 week later than when applied for apple scab.

73. Baldwin Spot.—The effects of a disease that somewhat resembles fruit spot of apples and is variously known as Baldwin spot, *fruit pit*, and *bitter pit* are numerous small, brown flecks throughout the diseased apples and especially in the outer $\frac{1}{2}$ inch of the pulp. During the early stages of the disease small spots or slight depressions resembling small bruises appear on the surface of the apples. The color of the spots, or pits, is practically the same as that of the apple on which they occur. Later, the pits become more distinct, showing as sunken areas of from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. In fact, as the disease advances, several of the pits may join and form one large pit. Also, the surface of the pits becomes dark brown. Baldwin apples are supposed to be especially susceptible to this disease, although other varieties are known to be attacked. It is reported to be worst during warm, rainy seasons and in the fruit on limbs or trees that have been weakened by canker or by overbearing. Also, the disease is more apt to appear in large overgrown than in medium-sized apples.

The cause of Baldwin spot is not known neither is there any known way to prevent it.

74. Apple Scald.—The skin of some apples changes while they are in storage to a brownish color. This change of color of apples in storage is known as apple scald, the first effects of which are the appearance of light-brown spots on the apples. These spots gradually enlarge until they finally cover the entire surface of the apple. The color changes to dark brown and finally may become almost black. At first only the skin and the outer part of the flesh of the fruit are discolored; later a large part of the flesh becomes discolored. The trouble is not definitely understood, but fruit that is grown and matured under favorable conditions will usually keep through its normal keeping season without injury.

75. Fire Blight.—The disease commonly known as fire blight, but also known as *twig blight*, is generally more serious on the pear than on the apple. The effects of the disease can be seen most readily in spring, about 3 weeks after the blossoming period, at which time many of the flower clusters shrivel and

die and the twigs turn black and dry up as if scorched by fire. During the winter the disease may be recognized by the leaves remaining on the diseased branches. This disease is caused by bacteria that gain entrance into the twigs either through the blossoms or through wounds. The disease travels downwards through the twigs at a rate of 2 or 3 inches per day if conditions are favorable, but has been known to travel 1 foot or more in a single day. However, under conditions favorable to the healthful growth of a tree, fire blight usually affects only a few inches of the tips of the branches.

Many of the diseased twigs and branches die the first year of the infection and the bacteria in the branches die also; but a few, probably only a very few, of the diseased branches remain alive, and it is in these branches that the bacteria live during the winter months. As the sap begins to flow during the spring, the infected twigs become the centers of infection and from them exudes a milk-like fluid that teems with the bacteria that are the direct cause of the disease. Young apples sometimes are infected and as a result become gorged with a slimy material that likewise teems with the bacteria that cause fire blight. Both the milk-like fluid in the twigs and the slime in the apples attracts insects, especially bees, which carry the bacteria to other parts of the tree or to other trees and thus spread the infection.

Fire blight cannot be controlled by spraying. The only known means of successfully combating the disease is by cutting out and burning every twig that shows infection. All apple, pear, quince, wild crab apple, mountain ash, service berry, and hawthorn trees in or within $\frac{1}{2}$ mile of the orchard should be examined and all twigs showing the effects of fire blight should be cut out and burned. The best time to cut out the diseased portions of the trees is probably during the fall, for the contrast between healthy and diseased twigs is readily seen at that time. In cutting out the diseased twigs the orchardist should remove the twig from 6 to 12 inches below the indication of the disease. If a cut should be made into diseased wood the knife or the cutting part of the pruning instrument used should be sterilized by wiping it with a cloth saturated with a

strong solution of bichloride of mercury, which is more commonly known as corrosive sublimate. A solution having a strength known as 1 to 1,000 should be used. Directions for making a solution of this strength can be secured from druggists who sell the material. All large wounds made in cutting out diseased branches should be disinfected with the corrosive-sublimate solution.

76. Root Rot.—In certain apple-growing sections many apple trees die without any visible cause for the trouble, but

on examination the root system of a dead tree will be found to be not only dead but partly decayed. Root rot is claimed to be most prevalent in orchards that have been planted on land that has recently been cleared of forest growth. Also, some investigators are inclined to associate the mushroom fungi known as *clitocybe* with the disease, and because of this association the disease is sometimes called *clitocybose*. As a matter of fact, it is reasonable to believe

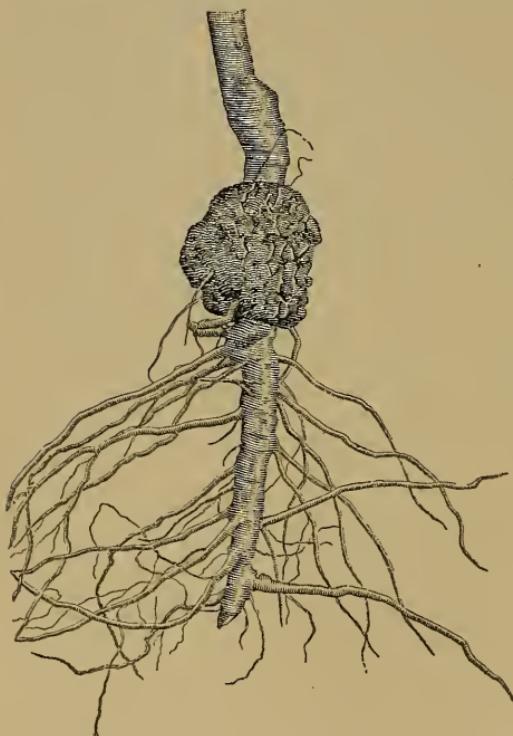


FIG. 62

that there may be several diseases that affect the root system of trees and cause their death.

As the first symptom of diseases that destroy the root systems of trees is the dying of the trees, practically the only means of control are those of prevention. It has been recommended

that all stumps and roots should be removed from the soil and one or two grain or other general farm crops be grown on it before apple trees are planted. All infected parts of diseased trees should be burned.

77. Crown Gall.—Growth such as the one shown in Fig. 62, and known as crown gall and also as *plant cancer*, are sometimes found on nursery trees. This disease is caused by bacteria and is very infectious. Apple trees should not be secured from nurseries in which crown gall is known to exist, and all trees showing this disease should be burned.

78. Mildew.—A dense, light-colored, felt-like fungous growth that sometimes occurs on the foliage of young apple trees is known as mildew. This disease is commonly found on young apple trees in the nursery, but it sometimes attacks rapidly growing young trees in orchards.

Mildew is easily kept from causing any considerable damage by spraying with Bordeaux or with lime-sulphur as recommended for any of the diseases that affect the foliage of the apple tree. If it is desired to treat the disease separately, as is sometimes the case in nurseries, an application of an ammoniacal copper-carbonate solution should be made as the leaves unfold and should be repeated every 2 weeks until time for budding.

MISCELLANEOUS INJURIES

79. Sun Scald.—The dying of the bark usually on the southwest side of the trunks of trees is sometimes known as sun scald. Sometimes the bark cracks and falls away from the tree; in other cases it does not. In Fig. 63 is shown the trunk of a young apple tree injured by sun scald. This injury is caused by the unequal heating of different sides of the trunk of the tree during the winter. Sometimes injury similar to sun scald is observed on the northeast side of the tree. Injury in such cases is claimed to be caused by a freeze occurring in the fall before the northeast side of the tree has become accustomed to cold weather. The northeast side of a tree is the last part to become dormant in the fall.

Sun-scald areas are easily infected by the spores of fungi that cause the various cankers, and for this reason all sun-scaled areas should be scraped down to healthy bark and wood and be painted.

Sun scald may be prevented by growing low-headed trees so that the branches may shade the trunk and by placing a tree protector around the tree during the winter. White-washing the tree trunk also tends to prevent the tree from becoming unduly heated on the side exposed to the direct rays of the sun.

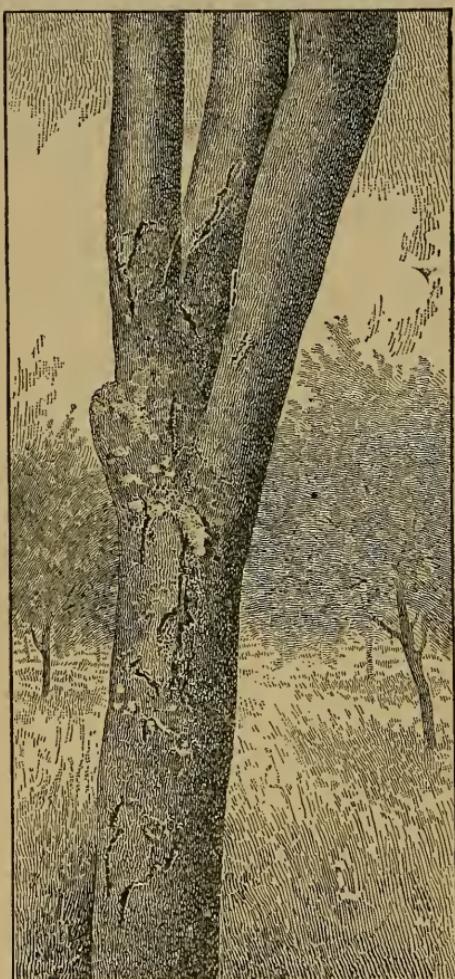


FIG. 63

80. Girdling of Trees.—Rabbits will eat bark from young trees and sometimes from trees 4 or 5 inches in diameter, from the surface of the ground to as high as they can reach. If the bark is eaten off entirely around the tree it will die, as plant-food cannot reach roots except through the live tissue of the bark. Mice often girdle small or even large trees near, or just below, the surface of the ground.

One of the best ways to prevent rabbits from eating the bark of trees is to kill the rabbits. If this is impracticable, a piece

of wood veneer or wire netting should be placed around the trunks. The wood veneer or wire netting should extend from the ground upwards for from 18 to 20 inches. In some

sections, instead of protecting each tree, the orchardist surrounds the orchard with a rabbit-proof fence. A wood-veneer protection around a tree with the soil banked up around the base of the protector is the best means of preventing injury from mice. However, if rubbish in which the mice may hide is not allowed to accumulate about the orchard but little injury will be caused by these pests.

81. Breaking of Trees.—The limbs of trees sometimes break under heavy crops of fruit in summer and under loads of ice in winter. To prevent the trees from being broken, the fruit should be thinned or the limbs should be held up by means of props. If small trees are heavily loaded with fruit the limbs on one side of the tree are sometimes tied by means of wire or cord to limbs on the opposite side of the tree. Sometimes a wire or cord is placed outside of all the principal branches and then drawn taut, thus supporting the branches of the entire top. If there is danger of the tree splitting down the trunk, a bolt should be placed through the body of the tree or through two opposite limbs in such a manner that they will brace each other. Probably the best means of preventing trees from being broken down by ice or by an exceptionally heavy crop of fruit is to keep the trees well pruned.

82. Bark Binding.—The bark of trees sometimes becomes so tough and rigid that it prevents the natural growth of the body of the tree. This condition of the bark may be caused by various conditions, such as a sudden checking of the growth of the tree, thus reducing its vigor; the rubbing of hogs or other livestock against the bark of trees; and the growth of lichens and other parasites on the bark.

Bark binding may be prevented by keeping the trees in a vigorous condition, by not pasturing hogs permanently in the orchard, and by spraying the trees sufficiently to keep the bark free from disease and in a healthy, growing condition.

After the bark has become bound, possibly the best remedy is to thoroughly scrape off all dead, loose, and diseased bark and if necessary to slit the bark up and down the trunk of the

tree. Pruning the trees severely so as to produce a vigorous growth will often accomplish satisfactory results.

83. Rough Bark.—On some trees the old bark breaks loose, keeping the body of the tree and main limbs very rough. This does not necessarily indicate an unhealthy condition of the tree, but the rough bark is a disadvantage in that it forms a sheltering place for insects like the codling moth, and is a possible host for some plant diseases. Many of the best orchardists scrape all the rough bark from the trees. To do this, a triangular trowel with a strong handle is used.

84. Spray Injury.—Although sprays are the most valuable remedies that orchardists can use in combating insects and fungous diseases that attack the apple orchard, the sprays sometimes cause injury to the foliage and fruit of the sprayed trees. The principal spray injury is that caused by Bordeaux mixture. This injury is commonly known as *Bordeaux injury*, and affects both the leaves and the fruit. The injury is much worse during rainy, wet, muggy weather than during dry, bright weather; it begins to appear in a few days after the spray is applied and continues to increase in extent for several weeks.

The injury causes the leaves to become spotted; at first the spots are very small and circular, but later they enlarge and become irregular in shape and the leaves may turn yellow and fall. In some cases as many as one-half of the leaves have reported to have fallen as a result of Bordeaux injury.

The injury on the fruit first appears as very small brown or black specks. These specks enlarge and cause on the mature apple the characteristic corky russetting like that on a Rhode Island Greening, shown in Fig. 64. Badly injured fruit is nearly always distorted somewhat in shape. The russeted areas are more or less shrunken and sometimes the half-grown injured apples are shrunken and cracked like those injured by scab, but they do not show the characteristic scabs. The late-keeping quality of apples is greatly reduced by Bordeaux injury, as is also the sale value of newly picked apples.

If lime-sulphur causes injury or russetting to the fruit it is so slight that investigators cannot distinguish the injury from the



FIG. 64

§ 6 24909

natural russetting of maturing fruit. Lime-sulphur does, however, cause some injury to the foliage. This injury consists of brown spots or brown margins appearing on the leaves and is supposed to be caused by the lime-sulphur becoming more saturated as it dries. Sometimes the entire leaves are affected at once, but *lime-sulphur injury* is at its worst in a few days after the spray is applied.

APPLE HARVESTING, STORING, AND MARKETING

HARVESTING OF APPLES

PICKING

1. Picking Receptacles.—A picking receptacle that is often used for apples is the round half-bushel basket with a swing handle, a form of which is shown in Fig. 1. Such baskets are easy to handle and when they are used there is less likelihood of the fruit being bruised than when larger receptacles are used. It is a good plan to line the baskets with burlap or some similar material, as shown in the illustration; this has a tendency to prevent bruising of the fruit. An S-shaped wire hook is usually attached to the handle in order that the basket may be hung on a limb, thus allowing the picker to have free use of both hands for picking.

In some sections, wide-topped 10-quart galvanized-iron pails are used as picking receptacles and are found to be very satisfactory. These pails are easier to handle than baskets, and, as



FIG. 1

a rule, will last longer, but they are somewhat more expensive. Burlap should be used for lining the pails to prevent bruising of the fruit.

In Fig. 2 is illustrated a patented fruit-picking receptacle that has some excellent features. It is simply a bottomless pail that is lined with canvas, the canvas extending below the lower rim of the pail. When the receptacle is being used to hold fruit, the draw string, which can be seen in the illustration, is pulled taut and the ring is placed over the hook on the side of the pail. When the pail is to be emptied it is lowered into

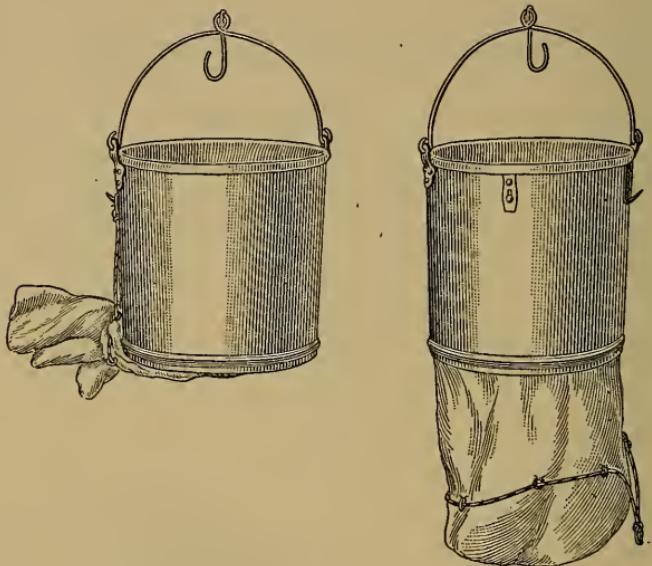


FIG. 2

the box or barrel, the draw string is released, and the fruit is allowed to pass out of the lower end of the canvas. By using the device in this way there is practically no bruising of the fruit.

In Fig. 3 is shown a picking receptacle that is used to some extent in the western part of the United States. It consists of a metal container that is made in such a way that it will break apart at the middle, a wire frame and a clamp for holding the two halves together, and a web strap for carrying the device. When the container is to be emptied all that is necessary is to

release the clamp, this allowing the container to break at the middle, as shown in Fig. 4.

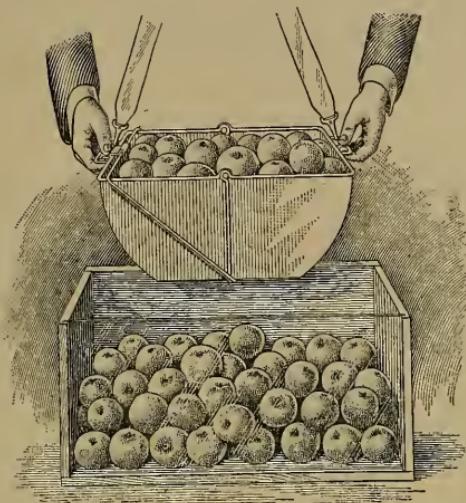


FIG. 3

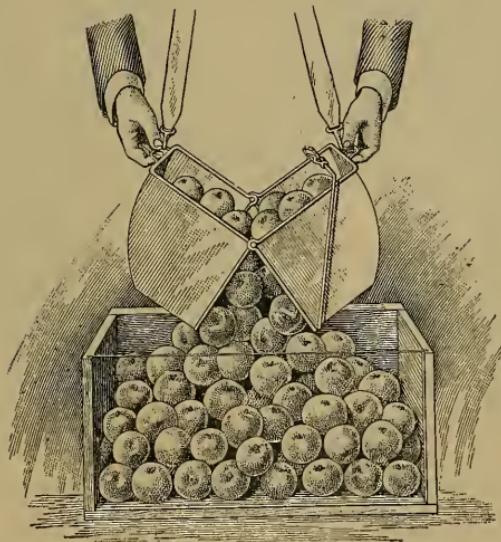


FIG. 4

Apple pickers often make use of a two-bushel grain sack as a picking receptacle. The sack is carried by means of a small

rope or strap, which is tied to a corner of the sack at each end and thrown over one shoulder of the picker, as shown in Fig. 5. Such a receptacle is convenient, as both hands are free to do the picking, but the fruit in the sack is almost sure to be bruised by the movements of the picker. For this reason, sacks are



FIG. 5



FIG. 6

unsatisfactory for picking receptacles and careful orchardists will not sanction their use.

In Fig. 6 is illustrated a receptacle known as the apron picking bag. This has been found to be a good picking receptacle particularly for fancy fruit. Such bags can be purchased cheaply

or they may easily be made at home. One of the principal advantages of this receptacle is that the fruit is not poured out but must be taken out carefully by hand. This may seem to be a disadvantage, but it should be remembered that fancy fruit must be handled without being even slightly bruised. Another



FIG. 7

advantage of the apron picking bag is that it hangs in a convenient position for the picker.

In Fig. 7 is shown a patented picking bag that is extensively used in some sections. The bag is emptied by loosening a draw string; this allows the apples to pass out through the bottom of the bag, as illustrated in Fig. 8.

A number of other patented picking receptacles that have more or less merit are on the market. Before purchasing one of these devices a grower should consider whether, by its use, there is a likelihood of the fruit being bruised. No form of picking receptacle that is likely to cause injury to the fruit should be used in an apple orchard.

2. Ladders.—It is important, when picking apples, to have a good supply of ladders available. The kind to use will depend

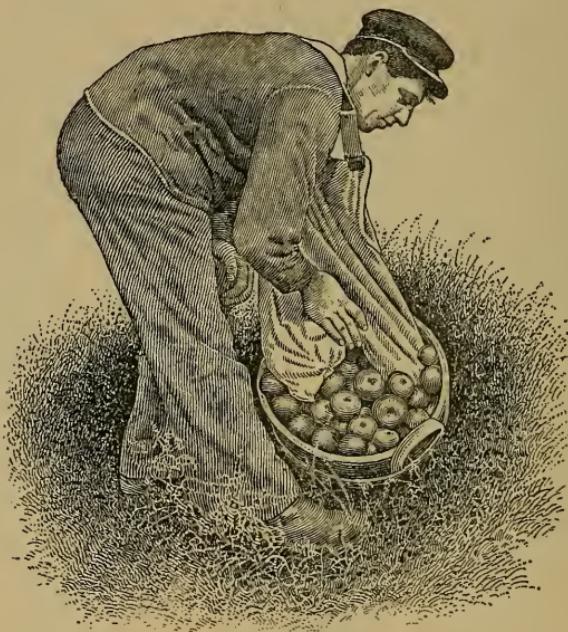


FIG. 8

largely on the height of the fruit above the ground. Where the fruit is hanging near the ground, step ladders are suitable. Of these there are two general types, the common step ladders with four legs and the so-called fruit ladders with three legs. Several forms of the latter are shown in Fig. 9. These ladders are especially desirable for use on uneven ground, as they will stand steadily and are not troublesome to move about the trees.

For fairly tall trees the so-called Japanese ladder, which is illustrated in Fig. 10 (a), is satisfactory. Ladders of this kind

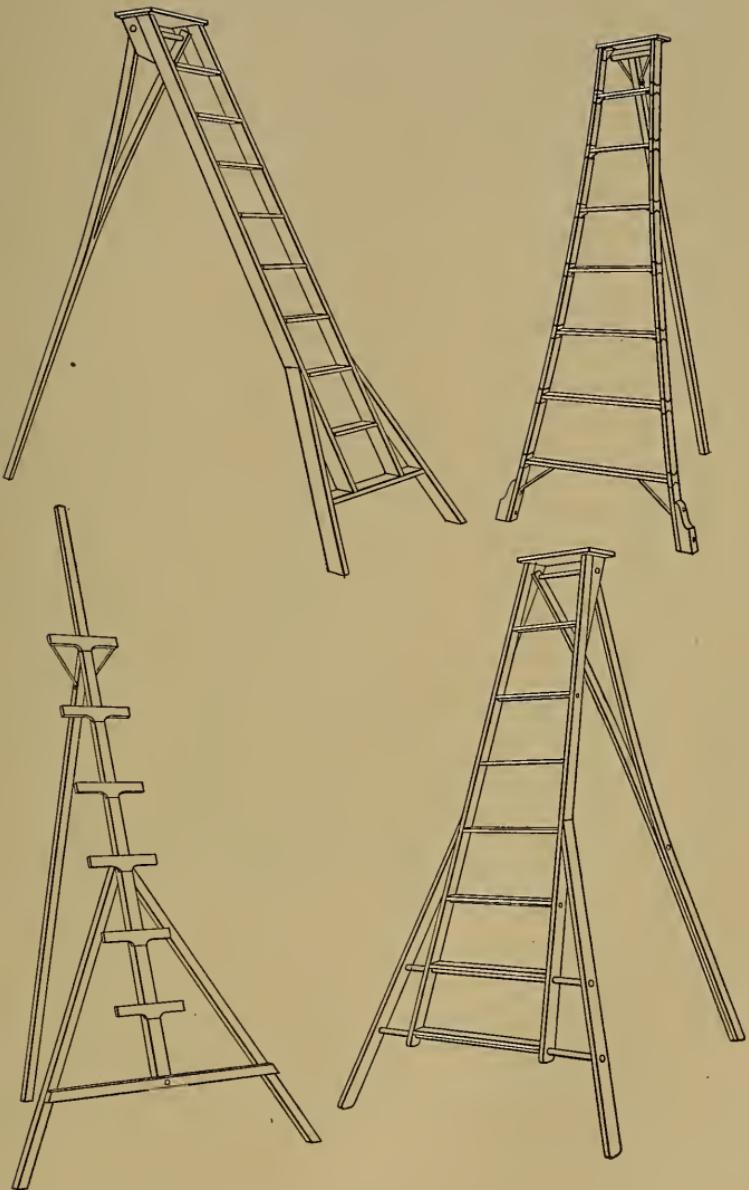


FIG. 9

are light, easy to handle, and are fairly stable on the ground. In Fig. 10 (b) is shown a form of ladder that can be easily transported from one part of the orchard to another. This ladder can be used with either the end *a* or the end *b* uppermost, as desired; if the fruit is high, the ladder should be placed so that the end *a* is uppermost, but if the fruit is near the ground, the ladder should be turned over so that the end *b* is uppermost. As a rule, ladders of this kind are made so that the end *a*, when uppermost,

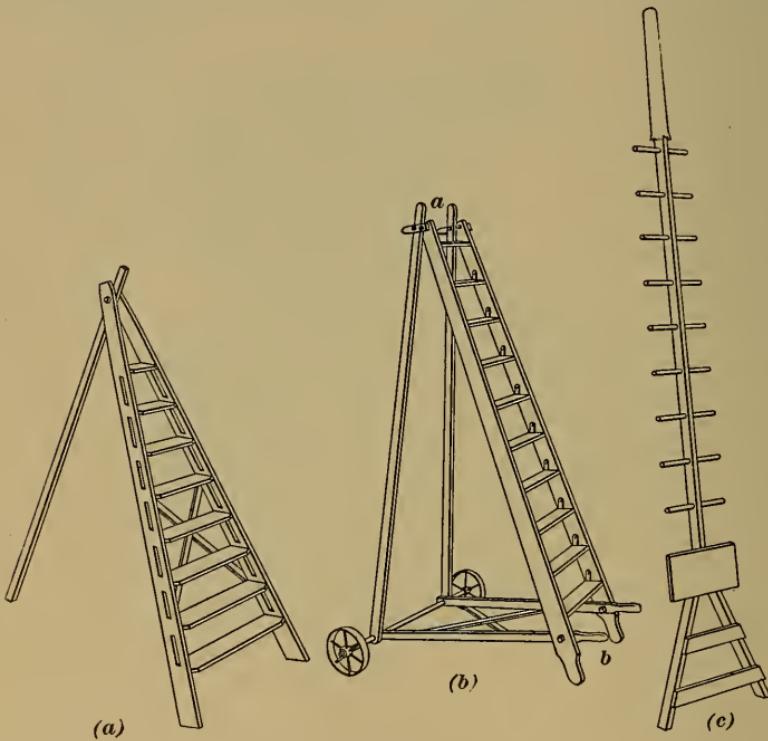


FIG. 10

is twice as high from the ground as the end *b*, when it is uppermost. The single-rail form of ladder, which is illustrated in Fig. 10 (c), is sometimes used when the fruit is on tall trees. This ladder, although light and easy to handle, does not stand very steadily.

In Fig. 11 are shown three forms of ladders that are used for picking fruit from high-headed trees. The form of ladder shown in (a) is termed regular; the forms shown in (b) and (c) are known

as pointed. The ladder shown in (c) is an extension ladder and is designed for picking fruit from very high trees. Regular ladders are generally placed against the sides of the trees and for this reason are not entirely satisfactory, as such practice is likely to break the branches. The so-called pointed ladders are provided with a strip of wood *a*, which may be placed in crotches formed by limbs. When used in this manner there is little danger of the ladder injuring the trees.

Another good form of picking ladder is the platform ladder, one of which is shown in Fig. 12. This

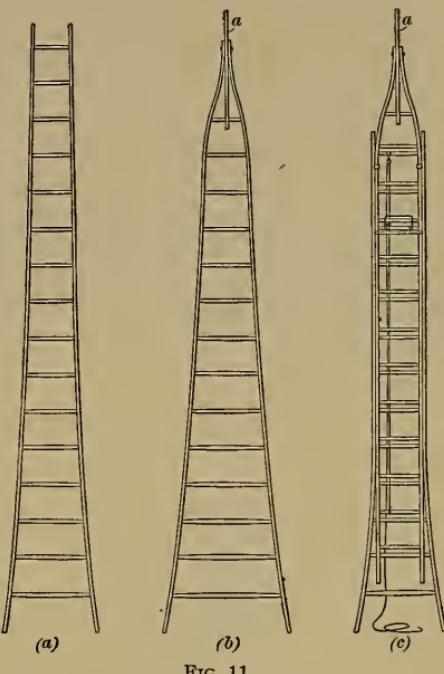


FIG. 11

ladder consists of three light ladders that are hinged onto a common support *a*. Two of these platform ladders with a

board *b* laid across them through the tree form a very desirable scaffold for use when picking apples that are in the center of trees, the pickers being able to get through the trees without injuring the fruit spurs or limbs.

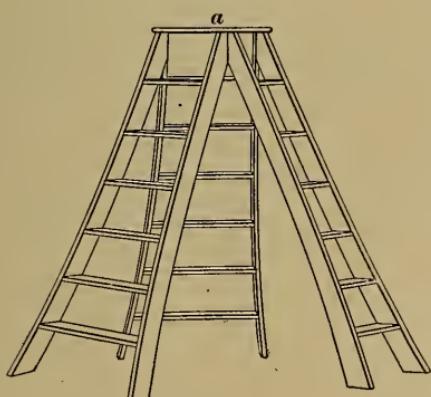


FIG. 12

3. Wagon for Use When Picking Apples.—For hauling fruit about an orchard

during the picking season, a low-down wagon, such as the one shown in Fig. 13 (a), is desirable, as less lifting of the fruit

packages is necessary than when an ordinary high-wheeled wagon is used. A frame of a size to hold a certain number of the packages being used should be built onto the wagon bed. When the distance between the trees will allow it, the frame should be made wide; if the trees are close together, the frame must, of course, be made narrow. It is important that

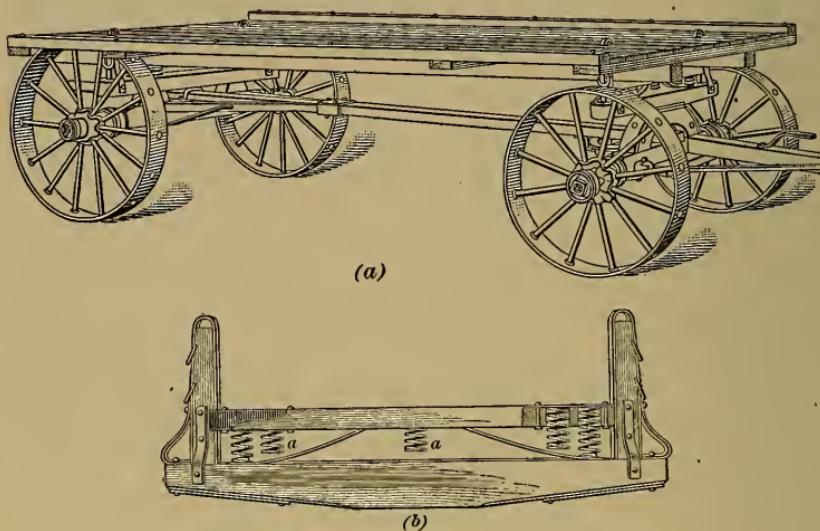


FIG. 13

the frame be strong in order that a large number of fruit packages can be hauled at a load. Bolster springs, a form of which is shown in Fig. 13 (b), should be used on the wagon to prevent jarring of the fruit.

4. Receptacles for Orchard Transportation of Fruit. For the transporting of apples from the orchard to the packing shed, crates such as those shown in Fig. 14 are convenient. The crates shown in (a) and (b) hold 1 bushel, and are light, easy to handle, and durable. Folding crates, such as those shown in (c) and (d), also are sometimes used for this purpose. Bushel boxes with a slot cut in each end, a form of which is shown in (e), are used in some sections. Some growers use an especially constructed box that holds about $1\frac{1}{3}$ bushels, made with the ends slightly higher than the side; such a box is shown in (f).

5. Methods of Picking.—Unless the crop is of poor quality, apples should be picked by hand, and each fruit, as it is taken from the tree, laid, not dropped, into the receptacle. The

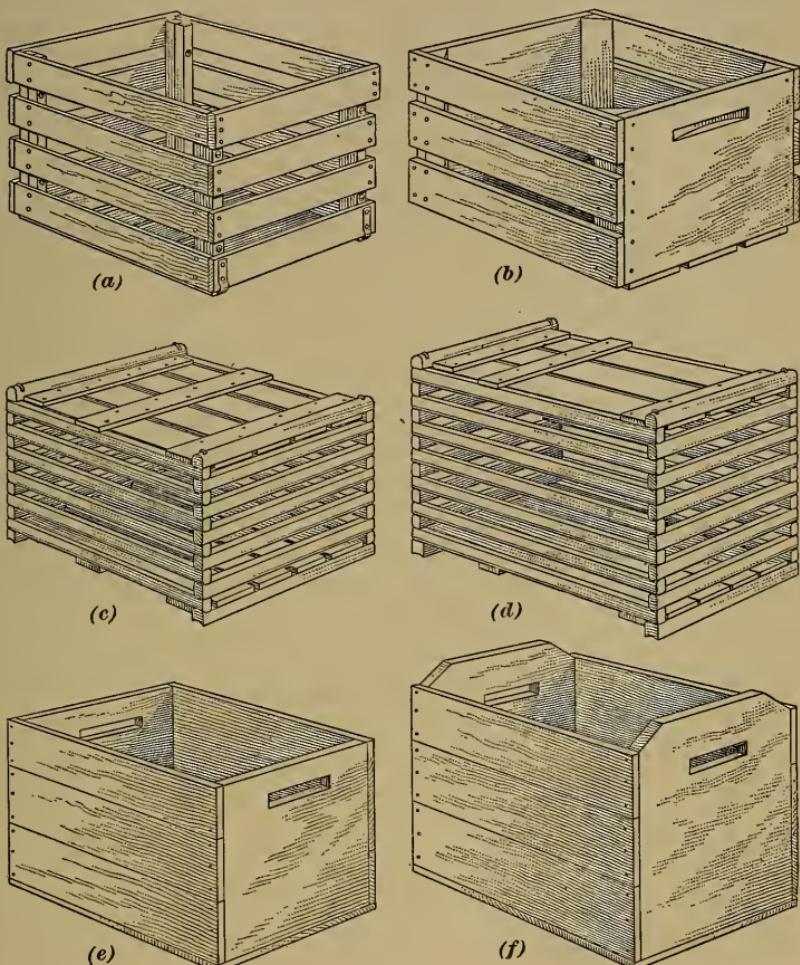


FIG. 14

dropping of an apple even a short distance will cause a bruise and thus injure the fruit.

Apples should always, if possible, be picked with the stems on, especially those that are to be kept for winter consumption; if the stem is pulled out, rot-producing organisms may get into

the fruit through the opening. A picker should exercise care, when picking apples, not to injure the fruit spurs. If the fruit is ripe enough to part from the spur readily when a slight twist is given to it, there is little danger of injury, provided the picker is careful.

Shaking of the trees should be resorted to only when the apples are to be used for evaporating or for cider making, or are to be sold as culls.

6. Time for Picking.—In general, it may be said that apples are ready for picking as soon as they have acquired a good color and will part from the spur readily. A good test for determining whether they are in condition to be picked is the color of the seeds; an apple picked just as the seeds turn a light brown, but before they become dark around the edges, will have a good flavor and will keep much better than if more mature when picked. Still it may not always be good management to pick the fruit when the seeds and the color indicate that it is ready for picking. Summer apples that are valuable primarily for cooking are often picked when they are not more than two-thirds ripe, and winter apples that are to be exported to a distant market, say from the United States or Canada to Siberia, are often, of necessity, picked rather green in order that they may be shipped early to avoid danger of freezing in transit.

Some varieties of summer apples ripen very unevenly and consequently it is necessary to make pickings at intervals of 2 or 3 days in order to get the fruit from the trees in the best condition. Other varieties, of course, ripen more evenly. In the case of fall and winter varieties, the fruit ripens more or less unevenly. Some progressive growers practice making two or three pickings and find that it pays. Most growers, however, follow the custom of picking all of the apples from a tree at the same time.

Varieties differ considerably as to the length of time the fruit will hang on the tree after becoming mature. The fruit of some varieties, if allowed to become very ripe before being picked, will rot at the core in storage. The Jonathan is an example of this class. The grower should, therefore, consider the variety

when deciding how mature the apples should become before they are harvested.

7. Management of Pickers.—In order that a large quantity of fruit may be harvested in a given time and that the fruit and the trees may be injured as little as possible, good executive ability is needed in managing apple pickers. Two general plans of hiring pickers are followed by growers, namely, hiring by the day and hiring by the bushel. Experience shows that there are advantages and disadvantages in both methods. As some pickers will do more work in a given time than others, there is likely to be dissatisfaction if all receive the same wages. It is possible, in a way, to overcome this difficulty by paying different amounts to different laborers, but this also may cause dissatisfaction and will require tactful management. Under some conditions it is possible to arrange the pickers into different groups and pay a different rate for each group. Mr. A. I. Mason, of Hood River, Oregon, follows this plan and finds it practicable. He employs old men and women who cannot climb ladders quickly to pick the fruit from the lower limbs, these pickers standing on the ground while working. The second group is made up of young girls who pick from low, light step ladders that they can handle easily. The third group is composed of young men who pick from tall ladders and remove the fruit from the tops of the trees. The rate of wages is, of course, different for each group.

If conditions are such that only men are available as pickers, any arrangement whereby different wages is paid to different groups would be very likely to cause dissatisfaction. For this reason, growers who hire by the day generally have a standard wage scale, and when a man is found to be doing poor work he is discharged.

An advantage of hiring by the bushel is that it is usually less expensive than hiring by the day, but there is, however, likely to be much breaking of branches and spurs and bruising of the fruit. Often a picker is found who picks a large quantity of fruit in a day but is very careless about breaking the trees and injuring the fruit. Such a man is really less desirable than one

who picks an average quantity of fruit but is careful of both fruit and tree.

The system of hiring to adopt should, of course, depend largely on conditions, but in most cases the wage system has proved to be the more satisfactory.

GRADING

8. Profits in Grading.—Proper grading of the fruit is a detail of the apple business that no grower should neglect. In fact, it is difficult to conduct an orchard profitably without careful grading of the product. Apples should be graded as to quality, size, and color. It is poor business to mix apples that will rot quickly with those that will keep, say, for several months, because the infection of the inferior fruit is soon carried to the sound fruit. It is poor business also to mix fruit of different sizes together in the packages offered for sale, for such fruit lacks much in appearance and will bring less on the market than fruit assorted to size. For box packing, which is described later, it is imperative that apples be very uniform in size. Those to be placed in the same box should not vary more than about $\frac{1}{4}$ of an inch, as it is extremely difficult to secure a uniform pack if the variation is greater. It is desirable to grade apples as to color, as this greatly improves the appearance. The price received for a package of fruit of uniform color is usually much greater than that received for a package of fruit of the same quality and size that is not so graded. Even in the case of fruit that is not highly colored, careful sorting to color causes it to have an improved appearance and consequently to sell for a higher price.

9. Number of Grades.—In many sections apples are graded into three grades, which are known, respectively, as *No. 1*, *No. 2*, and *culls*. If, however, apples are marketed by an association, or if the individual orchard is a large one, or if the fruit is sold on a local market, grades better than *No. 1*, known generally as *fancy* and *choice*, are likely to be very profitable.

The standard grades established by the United States government for apples packed in barrels and shipped or offered for

shipment in interstate or foreign commerce or sold or offered for sale in the District of Columbia or the territories of the United States are as follows: Minimum size $2\frac{1}{2}$ inches, $2\frac{1}{4}$ inches, and 2 inches.

10. Grade Standards.—The standards established by the National Apple Shippers Association are as follows:

Requirements for No. 1 Apples: The standard diameter size for No. 1 apples of such varieties as Ben Davis, Willow Twig, Baldwin, Greening, and others kindred in size, shall be not less than $2\frac{1}{2}$ inches. The standard diameter size for such varieties as Romanite, Russet, Winesap, Jonathan, Missouri Pippin, and other varieties kindred in size, shall be not less than $2\frac{1}{4}$ inches. In order to be graded as No. 1, apples must, at the time of packing, be practically free from worm injury, surface defacement, and broken skin; they must have been hand picked from the tree, and must be of a bright, normal color and shapely form.

Requirements for No. 2 Apples: In order to be graded as No. 2, apples must be of a diameter size of not less than $2\frac{1}{4}$ inches. They must have been hand picked from the tree, and must be free from broken skin and bruises. Apples of this grade must be packed with as much care as No. 1 fruit.

No standards for apples better than those grading as No. 1 have been established by the National Apple Shippers Association. The standards in vogue for such fruit are simply personal standards of individual growers or are those adopted by various fruit-growing associations. The Hood River Apple Growers Union, of the Hood River district in Oregon, has adopted the following requirements for apples shipped as fancy and choice:

Fancy Apples: The fancy grade consists of perfect apples only. They must be free from worm holes and stings; from scale, fungus, scab, rust, or any other disease; and from all insect pests, decay, and injury. They must be free from bruises and limb rubs, and the skin around the stem must not be broken. All apples must be clean, fully matured, and not deformed, and must have a healthy color. Spitzenburgs must have 70 per cent. or more of good red color. All red apples must be of good color.

Choice Apples: The choice grade consists of high-grade apples that are a little below fancy. Apples with worm holes or broken skin are not acceptable for this grade. Limb rubs must not be larger than a 10-cent piece. Only two stings will be allowed, and these are allowed only where neither sting has seriously broken the skin of the apple. No apples will be accepted that are infected with San José scale or dry rot, or that have an open or a black bruise. Apples having fungus spots larger than $\frac{1}{2}$ -inch in diameter are not acceptable for this grade.

The Yakima Valley Fruit Growers Association has adopted the following regulations with reference to the grades extra fancy, fancy, and C:

Extra Fancy Apples: Extra fancy apples are perfect, well-formed apples that are free from all insect pests, worm holes, stings, scale, scab, sun scald, dry rot, water core, or other defects. Limb rub, skin puncture, bruises, or other evidence of rough handling shall be considered defects. All apples heavily coated with dirt or spray must be cleaned. All the apples must be well matured and of natural color characteristic of the variety. Spitzenburg; Winesap, Jonathan, Arkansas Black, Gano, Lawver, and other solid-red varieties must have 75 per cent. of good red color. Ben Davis, Rome Beauty, Baldwin, Wagner, and other varieties of similar color must be 50 per cent. red. Red-Cheek Pippins and Winter Bananas must have a red cheek. Sizes smaller than 163 to the box should be excluded from this grade except that Winesaps may include sizes not smaller than 225. All apples of the extra fancy grade must be carefully wrapped and properly packed; the boxes should be lined with white paper, with cardboard on top and bottom only.

Fancy Apples: Apples of the fancy grade must be free from all insect pests, worm holes, stings, scale, sun scald, dry rot, water core, or other defects. Skin puncture, bruises or other evidence of rough handling shall be considered defects. Slight limb rub will be permitted. All apples must be well matured. Fruit of this grade must be carefully wrapped and properly packed; the boxes should be lined with white paper, with cardboard on top and bottom only.

C Grade Apples: Apples of the C grade shall be merchantable apples not included in the extra fancy or fancy grades. The apples must be free from all insect pests, worm holes, and scale, but will include misshapen apples or apples having a limb rub or other similar defect. Apples of this grade may also contain two worm stings or have slight bruises. They need not be wrapped and cardboard need not be used, but all boxes should be lined.

The United States government has enacted a law establishing standard grades for apples packed in barrels; this law applies, of course, only to apples that are shipped or offered for shipment in interstate or foreign commerce, or that otherwise are subject to federal jurisdiction. The following are extracts from this law:

Sec. 2. That the standard grades for apples when packed in barrels which shall be shipped or delivered for shipment in interstate or foreign commerce, or which shall be sold or offered for sale within the District of Columbia or the territories of the United States shall be as follows: Apples of one variety, which are well-grown specimens, hand picked, of good color for the variety, normal shape, practically free from insect and fungous injury, bruises, and other defects, except such as are necessarily caused in the operation of packing, or apples of one variety which are not more than 10 per cent. below the foregoing specifications shall be "standard grade, minimum size $2\frac{1}{2}$ inches," if the minimum size of the apples is $2\frac{1}{2}$ inches in transverse diameter; "standard grade, minimum size $2\frac{1}{4}$ inches," if the minimum size of the apples is $2\frac{1}{4}$ inches in transverse diameter; or "standard grade, minimum size 2 inches," if the minimum size of the apples is 2 inches in transverse diameter.

Sec. 3. That the barrels in which the apples are packed in accordance with the provisions of this Act may be branded in accordance with section 2 of this Act.

11. Methods of Marking Grades.—In the United States, the various grades of apples are generally marked No. 1, No. 2, fancy, choice, C, or culls. Unfortunately, however, No. 1 or No. 2 fruit is often marked fancy or choice, No. 2 is marked No. 1, or culls are marked No. 2. Such practice leads to confusion and is very unsatisfactory, especially when the fruit is offered on the general market or is exported, as the terms are likely to mean one grade in the case of one grower's fruit and another grade in the case of that of another grower.

The federal government has enacted a law regarding the marking of apples packed in barrels. Following are extracts from the law:

Sec. 5. That barrels packed with apples shall be deemed to be misbranded within the meaning of this Act—

First. If the barrel bears any statement, design, or device indicating that the apples contained therein are standard grade and the apples when packed do not conform to the requirements prescribed by section 2 of this Act.

Second. If the barrel bears any statement, design, or device indicating that the apples contained therein are standard grade and the barrel fails to bear also a statement of the name of the variety, the name of the locality where grown, and the name of the packer or the person by whose authority the apples were packed and the barrel marked.

Sec. 6. That any person, firm, or corporation, or association who shall knowingly pack or cause to be packed apples in barrels or who shall knowingly sell or offer for sale such barrels in violation of the provisions of this Act shall be liable to a penalty of one dollar and costs for each such barrel so sold or offered for sale, to be recovered at the suit of the United States in any court of the United States having jurisdiction.

In Canada, definite standard names have been designated by law for each grade of fruit. This avoids confusion and has been a means of securing a good reputation in England for Canadian-grown apples. Following are given extracts from the Canadian Fruit Marks Act of 1901, which deal with this phase of the fruit business:

4. Every person who, by himself or through the agency of another person, packs fruit in a closed package, intended for sale, shall cause the package to be marked in a plain and indelible manner, before it is taken from the premises where it is packed:

(a) with the initials of his Christian name, and his full surname and address;

(b) with the name of the variety or varieties; and

(c) with a designation of the grade of fruit, which shall include one of the following six marks: for fruit of the first quality, No. 1, or XXX; for fruit of the second quality, No. 2, or XX; and for fruit of the third quality, No. 3, or X; but the said mark may be accompanied by any other designation of grade, provided that designation is not inconsistent with, or marked more conspicuously than, the one of the said six marks which is used on the said package.

5. No person shall sell, or offer, expose, or have in his possession for sale, any fruit packed in a closed package and intended for sale, unless such package is marked as required by the next preceding section.

6. No person shall sell, or offer, expose, or have in his possession for sale, any fruit packed in a closed package, upon which package is marked any designation which represents such fruit as of No. 1 or XXX, finest, best, or extra good quality, unless such fruit consists of well-grown specimens of one variety, sound, of nearly uniform size, of good color for the variety, of normal shape, and not less than 90 per cent. free from scab, worm holes, bruises, and other defects, and properly packed.

7. No person shall sell, or offer, expose, or have in his possession for sale, any fruit packed in any package in which the faced or shown surface gives a false representation of the contents of such package; and it shall be considered a false representation when more than 15 per cent. of such fruit is substantially smaller in size than, or inferior in grade to, or different in variety from, the faced or shown surface of such package.

8. Every person who, by himself or through the agency of another person, violates any of the provisions of this Act shall, for each offense, upon summary conviction, be liable to a fine not exceeding one dollar and not less than 25 cents for each package which is packed, sold, offered, exposed, or had in possession for sale contrary to the provisions of this Act, together with the costs of prosecution; and in default of payment of such fine and costs, shall be liable to imprisonment, with or without hard labor, for a term not exceeding one month, unless such fine and the costs of enforcing it are sooner paid.

9. Whenever any fruit in any package is found to be so packed that the faced, or shown, surface gives a false representation of the contents of the package, any inspector charged with the enforcement of this Act may mark the words "falsely packed" in a plain and indelible manner on the package.

(2) Whenever any fruit packed in a closed package is found to be falsely marked, the said inspector may efface such false marks and mark the words "falsely packed" in a plain and indelible manner on the package.

(3) The inspector shall give notice, by letter or telegram, to the packer whose name is marked on the package, before he marks the words "falsely packed" or "falsely marked" on the package.

10. Every person who not being an inspector wilfully alters, effaces or obliterates wholly or partially, or causes to be altered, effaced or obliterated, any marks on any package which has undergone inspection shall incur a penalty of forty dollars.

The marking of packages of apples with various trade names is often practiced, and if used in addition to an honest mark of the grade such marking is often advantageous to a grower who sells his fruit on a local market or to a special trade, for the name may become an important factor in advertising the fruit from a particular orchard. In fact, it is likely to have much the effect of labels such as are described later.

12. Method of Grading.—The grading of apples to size can be done by means of machines that are on the market or it can be done by hand. A convenient plan, when grading by hand, is to have a table arranged with receptacles for the fruit,



FIG. 15

as shown in Fig. 15. A grading board, such as is illustrated in Fig. 16, will be found helpful, especially to an inexperienced grader. As shown in the illustration, this board has five holes of various dimensions. The board should be placed so

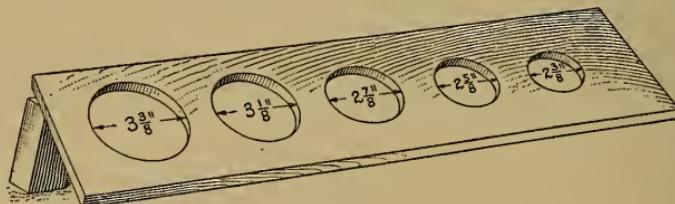


FIG. 16

that apples can be dropped through the holes quickly. After a little experience in grading fruit has been acquired, a grader will find that a grading board is not needed, as it will be possible for him to judge the size of an apple simply by looking at it.

PACKING

13. Packing House.—Some kind of a packing house or shed is almost a necessity if a large number of apples are to be packed. Growers sometimes pack the fruit in the open air, but, in this case, rainy or cold weather is likely to interfere with operations just at the height of the harvesting season. The packing house need not be an expensive affair, but it should be well lighted and be a comfortable place in which to work. The interior should be arranged conveniently with sorting and packing tables that will facilitate rapid and careful handling of the fruit.

14. Barrels for Apples.—In America, the barrel is still used more than any other package for apples, and market quotations are generally given in terms of this package. In New York, the largest apple-producing state, the law specifies the following with reference to barrels:

Barrels of Apples, Quinces, Pears, and Potatoes: A barrel of pears, quinces, or potatoes shall represent a quantity equal to 100 quarts of grain or dry measure. A barrel of apples shall be of the following dimensions: head diameter, $17\frac{1}{8}$ inches; length of stave, $28\frac{1}{2}$ inches; bulge, not less than 64 inches outside measurements.

The United States government has enacted a law establishing a standard barrel for apples. Following are extracts from the law:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the standard barrel for apples shall be of the following dimensions when measured without distension of its parts: Length of stave, $28\frac{1}{2}$ inches; diameter of head, $17\frac{1}{8}$ inches; distance between heads, 26 inches; circumference of bulge, 64 inches, outside measurement; representing as nearly as possible 7,056 cubic inches: Provided, That steel barrels containing the interior dimensions provided for in this section shall be construed as a compliance therewith.

Sec. 4. That all barrels packed with apples shall be deemed to be below standard if the barrel bears any statement, design, or device indicating that the barrel is a standard barrel of apples, as herein defined, and the capacity of the barrel is less than the capacity prescribed by section 1 of this Act, unless the barrel shall be plainly marked on end

and side with the word or figures showing the fractional relation which the actual capacity of the barrel bears to the capacity prescribed by section 1 of this Act. The marking required by this paragraph shall be in block letters of size not less than seventy-two point 1-inch Gothic.

In Canada, the law makes the following specification:

All apples packed in Canada for export for sale by the barrel in closed barrels shall be packed in good and strong barrels of seasoned wood, having dimensions not less than the following: $26\frac{1}{4}$ inches between the heads, inside measure, and a head diameter of 17 inches, and a middle diameter of $18\frac{1}{2}$ inches, representing, as nearly as possible, 96 quarts. When apples, pears, or quinces are sold by the barrel, as a measure of capacity, such barrel shall not be of lesser dimensions than those specified in this section.

A barrel usually has two hoops at each end and either one or two half way between each end and the bulge. In Fig. 17 are shown the two types. Barrel heads can be had in from two to four pieces. Often the heads can be procured with the parts held

together by means of wire staples. A head of this type is very convenient to handle.

Large growers or associations often buy sawed-out material for barrels and put the parts together on their own premises. This practice saves freight charges and enables



FIG. 17

the grower to make use of labor in seasons when orchard work is not pressing. Barrels used for apples should always be new and clean; the practice of using second-hand or soiled barrels is unsatisfactory, and is often the means of losing sales.

15. Boxes for Apples.—The bushel apple box, two forms of which are shown in Fig. 18, is coming into wide use, especially for the best grades of apples. Fancy apples that have been carefully graded, for example, are often handled at a better profit

in boxes than in barrels. The standard-sized box in Canada is 10 in. \times 11 in. \times 20 in., inside measurement. In the United States, some growers use a box 10 in. \times 11 in. \times 20 in., and others use one that is 10 $\frac{1}{2}$ in. \times 11 $\frac{1}{2}$ in. \times 18 in.; these are the two forms illustrated. In the northern part of the United States, the 10 $\frac{1}{2}$ " \times 11 $\frac{1}{2}$ " \times 18" box is often termed by growers the standard box, and the 10" \times 11" \times 20" box, the special box.

In the making of apple boxes, $\frac{3}{4}$ -inch material is used for the ends, $\frac{3}{8}$ -inch material for the sides, and $\frac{1}{4}$ -inch material for the

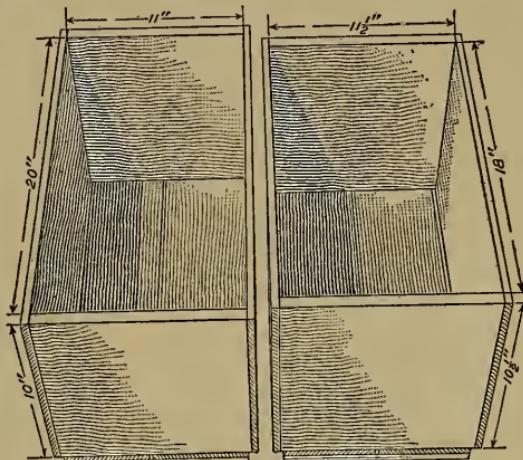


FIG. 18

top and the bottom. The sides need to be thick enough not to bulge, but the top and bottom should bulge easily, but not break. The ends need to be thick enough to hold the nails well and to

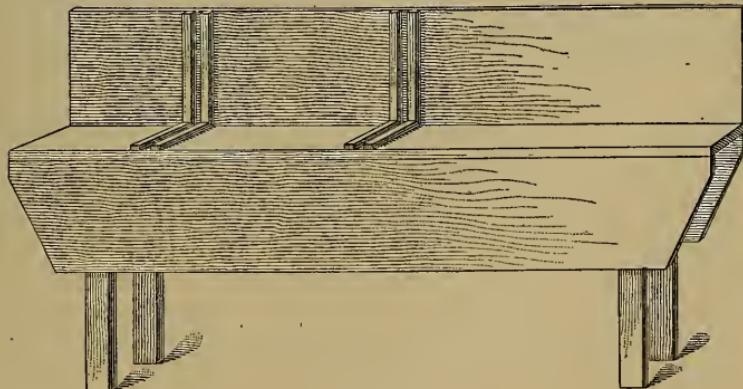


FIG. 19

give strength to the box. Cleats about $\frac{3}{4}$ -inch wide are usually used across each end of the top and bottom. Spruce is a desirable wood for apple boxes; it is white, neat in appearance, and

does not split easily when nailed. The lumber for boxes is practically always bought sawed to the right dimension, the boxes being made up at the orchard. This buying of the material knocked down reduces expense.

In nailing a box, four 4-penny nails are generally used for each end of each side, and four for each end of the top and the bottom, the box thus requiring thirty-two nails. When a box is being put together it is well to have some kind of a form to hold the ends in place while the nails are being started. In Fig. 19 is shown a bench with a form for this purpose. The two ends for the box are placed in the grooves on the bench, and two pieces of the side nailed to them. The ends and the side are then turned and the other side and bottom are nailed in place.

A good workman can put together from one hundred to two hundred boxes a day.

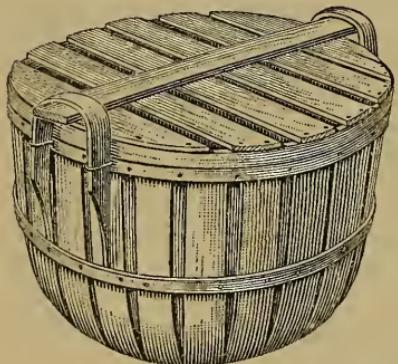


FIG. 20

16. Bushel Baskets for Apples.—For a local market, the bushel stave basket, one of which is illustrated in Fig. 20, has been found to be fairly satisfactory. These baskets are light, durable, inexpensive, and easy to pack and to handle. For use on a general

wholesale market they are not satisfactory, however, because the trade is not accustomed to purchasing apples put up in this way. A further objection to their use is the fact that they cannot be piled more than four or five high without injury to the fruit in the bottom baskets.

17. Packing of Apples in Barrels.—The first operation in packing a barrel of apples is to fasten securely the end that is to be the top by driving four 5-penny nails into each piece of the head, as shown in Fig. 21. The nails should be driven obliquely through the upper hoop, the end of the stave, and into the wood of the head. Two liners—small, flexible strips of wood—are then nailed across the ends of the pieces of the head, the liners

following the curve of the barrel. If the liners are not flexible enough to fit readily to this curve, they should be placed in water for an hour or so before being used. For the liners 3-penny nails should be used, the nails being clinched on the outside of the barrel.

The next step is to nail the hoops—except the two on the end that will be uppermost while the barrel is being filled—to the staves of the barrel by driving two 3-penny nails through each hoop, one on each side of the barrel, as shown in Fig. 22. These



FIG. 21



FIG. 22

nails will go through the staves and, in order to prevent injury to the fruit, must be clinched later.

The barrel is next reversed so that the end formerly at the top rests on the floor, the two upper hoops are loosened, the head is removed, and the nails that have been driven through the hoops are clinched. A circle of paper the size of the end is then placed in the bottom of the barrel.

The barrel is now ready for filling, and in order that the package, when opened, will make a good appearance, the apples that are placed in what is now the bottom are arranged in regular order, or *faced*. Fig. 23 shows the appearance of a well-faced barrel after being opened at the top. The face should be made

up of apples that are about an average of those that go into the package.

It is unwise as well as dishonest to use better apples for the face than for the interior, as experienced buyers are not usually misled by such practices. The apples of the face are placed stem end down for two reasons: first, the face will be more attractive, and, second, the stem end usually presents a broader surface to come in contact with the head, and thus the skin of the apples is less likely to be bruised when the barrels are handled. In arranging the face, the packer secures several apples of uniform size and color and places them around the outer edge of what is now the bottom of the barrel; next he lays another circle of fruit just inside of the first one and so on until the face is completed; usually one apple is placed in the center, this completing the layer.

It is important that the apples be fitted in firmly, but not so firmly that the layer will tend to bulge badly, because in this case after the barrel is packed some of them may turn over on the side, or *buckle*, as fruit men say, and the barrel will show a disarranged face when opened.

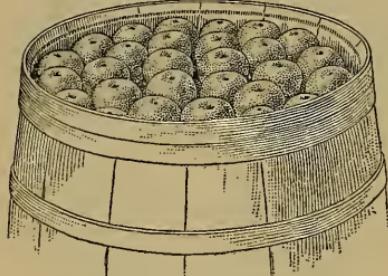


FIG. 23

Packers generally place a second layer in the barrel by hand. Some make a practice of arranging this layer in the same manner as the first and thus really make a double face; others simply place the apples cheek downwards at the joints made where three apples of the face come together. After the placing of the second layer the barrel is ready for further filling. If the fruit has been sorted into baskets, or pails, these should be lowered one at a time into the barrel and the fruit emptied. In no case should the apples be dropped from a height of more than a few inches. Some orchardists, when packing apples, make use of a table like the one illustrated in Fig. 24. The fruit is allowed to run into the barrel from the table, the lower end being removable. Growers who use this table try to avoid bruising of the fruit by having a length of burlap extend into the barrel; they claim that the

apples, in falling on the burlap, will not be bruised. Such practice is not to be recommended, for no matter how careful the packer may be, the fruit is likely to be bruised. The careful emptying of a pail or basket of fruit will require a little more

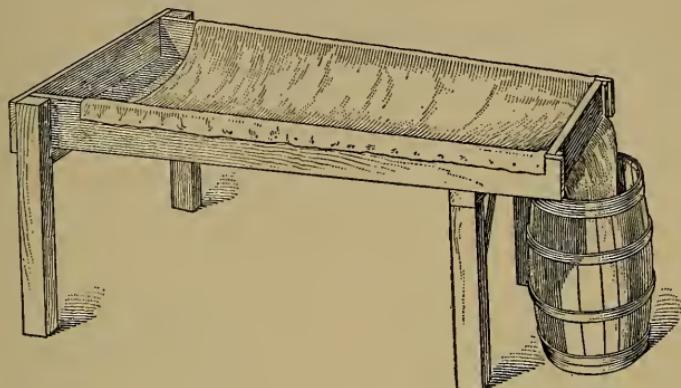


FIG. 24

time than rolling the apples from a table of this kind, but fewer apples will be injured.

When the barrel is about one-third full it should be *racked*, that is, jarred slightly in order that the fruit will settle. This is accomplished by rocking the barrel back and forth, being careful not to allow the edge to get more than about 2 or 3 inches off the floor. The filling is then continued until the barrel is about two-thirds full, when it is again racked. Following this racking, it is filled to within an inch or two of the chime, the exact distance depending on the size of the apples and on the variety. A follower, one of which is shown in Fig. 25, is now placed on the apples and held there and the barrel racked for the last time. The follower is used to hold the apples in place and level the fruit preparatory to arranging the last apples in the barrel.

This accessory is easily constructed, being simply two or three boards nailed together and cut to fit the shape of the barrel; it is provided with a handle and is padded with burlap or other thick cloth. The arranging of the last apples in the barrel is known as *tailing*, and is one of the most difficult operations of apple



FIG. 25

barreling. The apples are placed with stems up and are arranged in regular order, much the same as in the face, although, as a rule, they are not placed in concentric circles, but are merely arranged in a level layer. The main object of tailing is to secure an even surface in order that the head, when placed in position, will hold all the apples in the barrel snug and firm. The top of this last layer of apples should extend to, or, in some cases, slightly above the ends of the staves. When the head is put on the barrel the apples will be forced down into the barrel, but this is necessary, or otherwise the barrel will become *slack*, as fruitmen say, and much fruit will be injured by rolling about in the barrel. Inex-

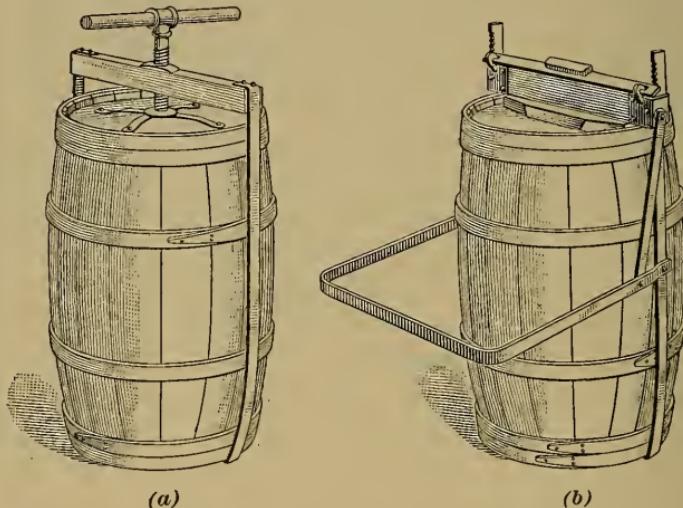


FIG. 26

perienced packers often fail to have the apples far enough above where the head will be placed. It is surprising how much pressure a barrel of apples will stand without much injury to the fruit. Thick-skinned apples like Ben Davis and Gano will stand more pressure without injury than thin-skinned apples like Northern Spy and McIntosh, but even thin-skinned varieties must be pressed down sufficiently to avoid slackness in the barrels. Above the last layer is generally placed a circle of paper similar to that used in the face end.

After the tailing is finished, the barrel is headed. For this work, use is made of what is known as a barrel press, two forms

of which are shown in Fig. 26, the one shown in (a) being a screw press, and the one in (b) a lever press. Both forms are in common use among packers, some preferring one form and some the other.

When a barrel is to be headed the upper hoop is removed, the one just below it is loosened by being driven upwards, the head is laid in place on the apples, and the lower part of the press is caught under the bottom of the barrel. But before the apples are pressed into the barrel, the top hoop is slipped onto the barrel so that it can be driven downwards to tighten the staves before the press is removed. When all of these details have been arranged pressure is exerted and the head is forced down to the chime. The hoops are then driven downwards to their proper position and the top is nailed and liners put in place, as was done in the case of the other end. To avoid splitting the hoops when driving them to place, it is well to make use of a **hoop follower**, a piece of hard wood shaped as shown in Fig. 27. After being headed the barrel is turned over and the grade marked on the top. It is then laid on its side, as there is less likelihood of it becoming slack than if left on end.

18. Packing of Apples in Boxes.—Of recent years, the packing of apples in bushel boxes has come into vogue in many parts of the United States and Canada. This style of package is especially desirable for choice and fancy fruit, well-packed boxes of these grades often bringing excellent prices.

One of the first requisites for good and rapid box packing is a properly constructed packing table. Fig. 28 shows an approved form of table that will hold three or four bushels of apples and accommodate two packers. It is simply a burlap-covered frame supported by legs and having boards arranged at the ends for supporting the boxes to be packed. The dimensions shown in the illustrations can, of course, be varied to suit the convenience of the packers. Two layers of burlap are used on the frame, the bottom one being nailed and the top one merely hooked in place so that it can be removed easily to enable the packer to shake off

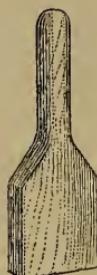


FIG. 27

any leaves and dirt that accumulate. A piece of garden hose is nailed around the top edge of the table to prevent bruising of the

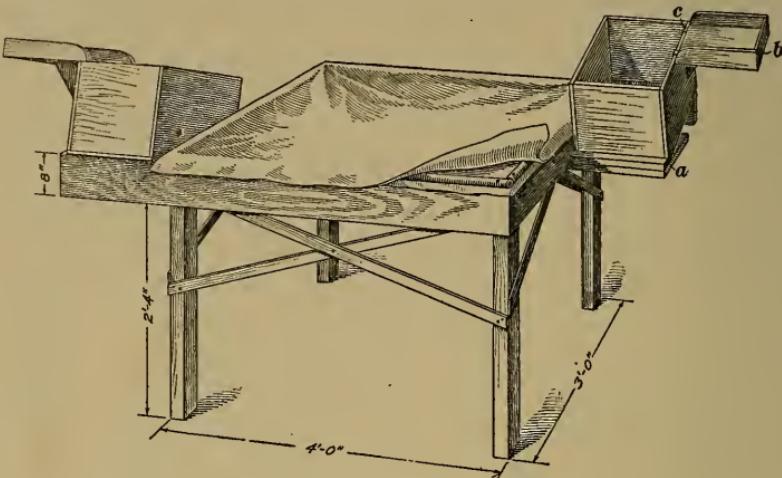


FIG. 28

fruit. When being packed, the boxes are tilted as shown in the illustration and are prevented from slipping by the strip *a*.

The hood *b* is for holding sheets of wrapping paper, the use of which is discussed later. The hood, which is removable, is held in place by two right-angled hooks *c* and a bracket that supports it against the side of the box.

The sides, bottom, and top of apple boxes are generally lined with white paper. Newspaper stock is extensively used for

this purpose, although in some localities the growers prefer a glazed paper. The sheets of paper are cut so that they are

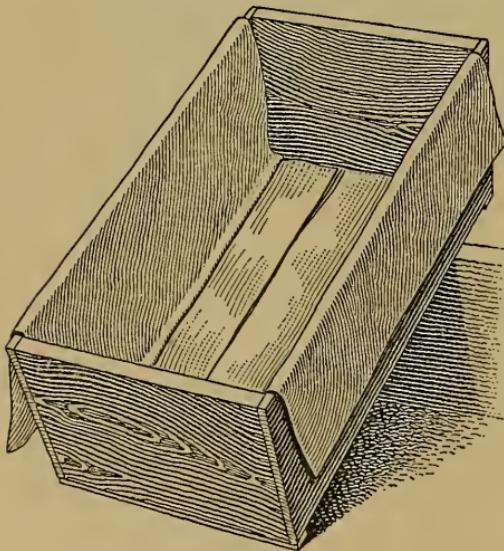


FIG. 29

slightly narrower than the length of the box. Two are used for a box, each sheet covering a little more than half the bottom, all of the side, and about half of the top. To avoid tearing of the sheet where the bottom of the box is joined to the side when the bottom bulges after the top is nailed, the sheets are plaited at the place where they will come in contact with this part of the box. While the box is being filled, the paper that will cover the top hangs over the sides. Fig. 29 shows a box lined and ready for packing.

At the top and bottom of the boxes, and sometimes between the layers of fruit, sheets of unglazed paper or cardboard are placed. This gives a neat appearance to the pack, and is useful in taking up inequalities between the layers, and in preventing rubbing of the fruit while the cover is being nailed.

Box-packed apples are generally wiped before being placed in the package, especially if the fruit was sprayed late in the season with a spray mixture containing lime. But even if no spray that will whiten the fruit has been used, it is probably a good plan, on account of the improved appearance of the fruit, to wipe off the dust. A pair of cheap cotton gloves is better for wiping apples than a rag, as the operation is done more quickly and the gloves protect the hands from the cold. The Hood River Apple Growers Union instructs its members as to the wiping of fruit as follows: Wipe the apples just enough to make them clean and get off the spray. Do not polish them.

Growers find, as a rule, that in box packing it pays to wrap each apple in paper. Wrapped fruit is easier to pack than unwrapped, it goes into the market looking fresher, there is no opportunity for decay to spread from one apple to another, and if the packing is well done there is little chance of the package becoming slack. On the other hand, wrapped fruit requires slightly more time for packing, there is a cost of 2 or 3 cents a box for paper, and when the box comes to market the fruit cannot be seen at a glance as can unwrapped fruit.

Newspaper stock is good paper for wrapping fruit. The size of sheets to use will depend, of course, on the size of the apples, the average sizes of sheets being 8 in. \times 10 in., 10 in. \times 10 in., and 10 in. \times 12 in.

Not much time is required to wrap an apple. The method is as follows: A sheet of paper is grasped from the holder on the packing table with one hand, and an apple from the table with the other hand, and the two brought together over the box, and as the apple is placed in the box, the paper is folded around the fruit, its ends being kept underneath by the weight of the apple. In order that one sheet of paper may be grasped at a time packers find it convenient to wear a rubber stole on the thumb or first finger of the left hand.

The apples are placed in the box in layers, and for this reason it is imperative that they be uniform in size. The arrangement of the layers may

be in one of three ways known, respectively, as the *straight*, the *diagonal*, and the *offset pack*.

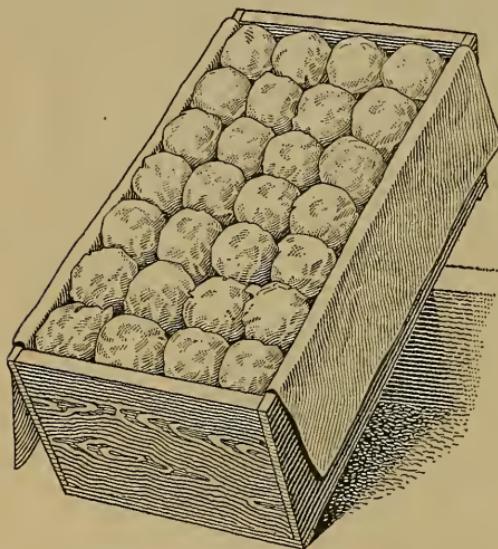


FIG. 30

the straight pack, the apples are placed in straight rows lengthwise and crosswise of the box, as shown in Fig. 30. This is one of the most difficult packs to make, especially if the fruit is not graded accurately to size. Each layer in the box is the exact duplicate of each other layer, containing the same number of apples placed directly over those of the preceding layer. Only apples of approximately the same size can be packed in this way, as otherwise the rows will not come out even.

Packs of this kind may be arranged in 5, 4, or 3 tiers, the arrangement depending on the size of the fruit. These packs are known, respectively, as 5-tier, 4-tier, and 3-tier packs. In a 5-tier pack there will generally be 8 cross-rows, or 40 apples to the layer, and 5 layers to the box, thus making 200 apples to the

box. A 4-tier pack has, as a rule, either 6, 7, or 8 cross-rows, or 24, 28, or 32 apples to the layer, and 4 layers to the box, making 96, 112, or 128 apples to the package. In a 3-tier pack, there are generally either 5 or 6 cross-rows, or 15 or 18 apples to the layer, and 3 layers to the box, making 45 or 54 apples to the package.

The straight pack presents a neat appearance, but there is likely to be considerable bruising of the fruit, as each apple is directly above or below some other apple.

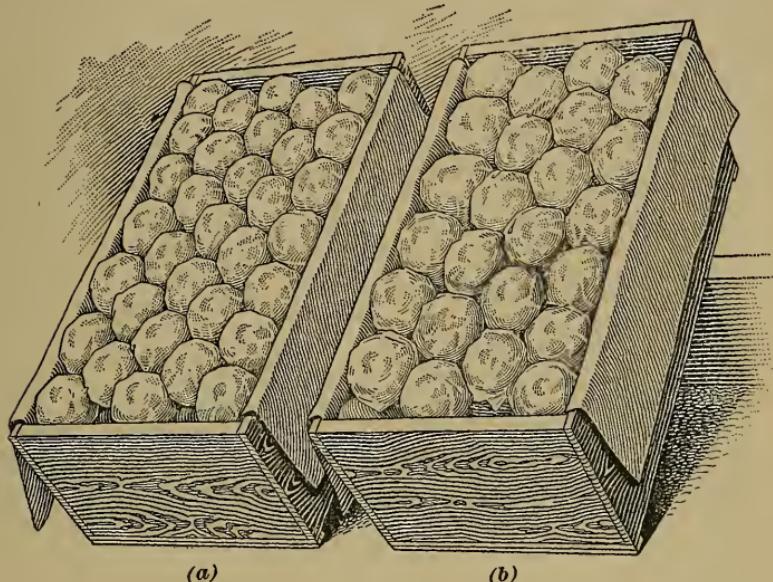


FIG. 31

20. In a **diagonal pack**, so named from the diagonal course of the rows, the apples are arranged as shown in Fig. 31. Packers usually prefer this pack to the straight pack because it is easier to make and the apples can be packed with a little less careful grading. In (a) is shown what is called a 3-2, or $4\frac{1}{2}$ -tier, pack. The 3-2 has reference to the number of apples in the cross-rows, there being three in the first row, two in the second, and so on; the expression $4\frac{1}{2}$ -tier is derived from the fact that there are three complete and two incomplete tiers, which, if placed end to end, would make $4\frac{1}{2}$ solid tiers. The number of apples in a $4\frac{1}{2}$ -tier box ranges from 150 to 200. In (b) is shown

what is known as a 2-2 diagonal, or a $3\frac{1}{2}$ -tier, pack. As a rule, there are 64, 72, or 80 apples in a pack of this kind.

To start a 3-2 diagonal pack, an apple is placed in each corner of one end of the box and a third midway between them. There will thus be left two open spaces, neither of them as wide as the diameter of one of the apples. These spaces will, however, allow the two apples of the second row to partly slip between those

TABLE I
DATA CONCERNING STRAIGHT AND DIAGONAL BOX PACKS

No. of Apples per Box	Tier	Pack	No. of Apples per Tier	No. of Layers	Size of Box Used
45	3	Straight	5	3	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
54	3	Straight	6	3	$10'' \times 11'' \times 20''$
63	3	Straight	7	3	$10'' \times 11'' \times 20''$
64	$3\frac{1}{2}$	2-2 Diagonal	4-4	4	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
72	$3\frac{1}{2}$	2-2 Diagonal	4-5	4	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
80	$3\frac{1}{2}$	2-2 Diagonal	5-5	4	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
88	$3\frac{1}{2}$	2-2 Diagonal	5-6	4	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
96	$3\frac{1}{2}$	2-2 Diagonal	6-6	4	$10'' \times 11'' \times 20''$
104	$3\frac{1}{2}$	2-2 Diagonal	6-7	4	$10'' \times 11'' \times 20''$
112	$3\frac{1}{2}$	2-2 Diagonal	7-7	4	$10'' \times 11'' \times 20''$
120	$3\frac{1}{2}$	2-2 Diagonal	7-8	4	$10'' \times 11'' \times 20''$
128	4	Straight	8	4	$10'' \times 11'' \times 20''$
144	4	Straight	9	4	$10'' \times 11'' \times 20''$
150	$4\frac{1}{2}$	3-2 Diagonal	6	5	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
163	$4\frac{1}{2}$	3-2 Diagonal	6-7	5	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
175	$4\frac{1}{2}$	3-2 Diagonal	7-7	5	$10\frac{1}{2}'' \times 11\frac{1}{2}'' \times 18''$
188	$4\frac{1}{2}$	3-2 Diagonal	7-8	5	$10'' \times 11'' \times 20''$
200	$4\frac{1}{2}$	3-2 Diagonal	8-8	5	$10'' \times 11'' \times 20''$

of the first row. The second row has three open spaces, consequently there will be three apples in the next row; in the next there will be two, and in the next three, and so on until the other end of the box is reached. Sometimes the last row will contain two apples and sometimes three, depending on the size and the shape of the fruit. In starting the second layer of a 3-2 pack, two apples instead of three are placed for the first row; these two apples will fit in the two spaces left by the three apples of the corresponding row in the first layer. The apples of the second

layer tend to fill up the vacant spaces of the first layer. The third layer is begun with three apples, and the fourth with two; thus the odd-numbered layers are alike, and the even-numbered ones are alike.

The 2-2 diagonal pack is used for apples that are too large for a 3-2 pack. It is started by placing an apple in one corner of the box and a second one midway between this first apple and the other side. The two apples of the second row are then placed to fit into the open spaces thus left; the third row is then placed like the first one, and the fourth, like the second, and so on until the layer is finished. In starting the second layer, the apples are placed just the reverse of the way they were in the first layer, the first row coming over the opening between the apples of the first row beneath and the second over the opening in the second row of the first layer, etc.

In Table I is given data concerning straight and diagonal box packs. This table is compiled from information published by Prof. C. I. Lewis, of the Oregon Agricultural Experiment Station.

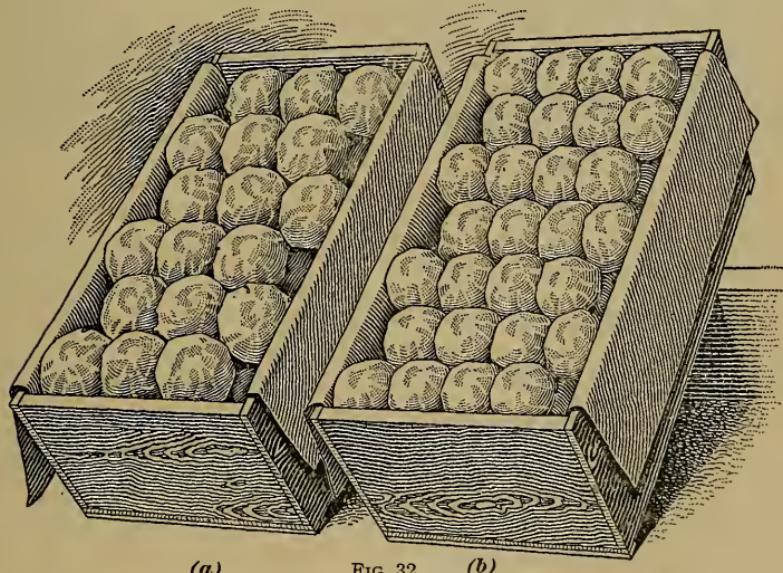


FIG. 32

21. The **offset pack** resembles the diagonal pack in appearance but differs in the arrangement of the fruit. The two forms

of the offset pack that are most commonly used are shown in Fig. 32; in (a) is shown the form known as the 3-3, or $3\frac{1}{2}$ -tier, pack and in (b) is shown the form known as the 4-4, or $4\frac{1}{2}$ -tier, pack.

The 3-3 offset pack is started by placing three apples in one end of the box so that they touch each other and one of them touches the corner of the box. This leaves a space at the opposite corner. The size of the apples should be such that the space at the side of the row is about equal to one-third or one-half of the diameter of each fruit. The second row of three apples is started on the opposite side of the box, the first apple fitting down partly into the open space of the first row. The third row is started on the same side as the first, and this alternating is continued until the layer is complete. The first row of the second layer is started on the opposite side of the box from the first row of the first layer and the rows are alternate as in the first row. The third layer is like the first and the fourth like the second, and so on.

The 4-4 offset pack is like the 3-3 pack except in the number of apples in a row.

The offset pack is an easy one to make, but the large open spaces at the sides give much opportunity for the box to become slack. In addition, these spaces give the appearance of the box not being full, which is likely to injure its sale.

22. No matter which pack is used, the shape of the apples determines whether they shall be placed on the end or the side. As a rule, round or oblate apples are packed on end and oblong varieties on the side. However, to secure the proper bulge described later, some of the apples in a box may be turned one way and some the other way.

It is obvious that to avoid bruising of the fruit the boxes must be packed so that they will not become slack in transit. Therefore, firmness of the pack is of prime importance. Each apple should be fitted snugly and tightly into place, but, of course, pressure enough to bruise the fruit should not be applied. Apples will shrink somewhat in storage and this makes firmness of the pack doubly important. To insure a firm pack, the fruit

should extend to the ends of the box. Often fruit is packed so that there is as much as a quarter of an inch of space at the end of the box but such practice should be avoided. If the packer finds that a layer is not coming out well he should repack a few rows choosing slightly larger apples, or turning a few on the side or on the end, as the case may require. By exercising judgment in selecting the apples as the packing is being done, a novice will soon learn to make a firm pack.

A bulge at the top and the bottom of the box is necessary to avoid slackness in a packed box of apples, as the spring of the boards will keep the fruit firm even after it shrinks slightly. Most packers like a bulge of $\frac{3}{4}$ inch on both the top and bottom. To get this bulge it is necessary that the apples be packed so that the last layer of apples comes out about flush with the two

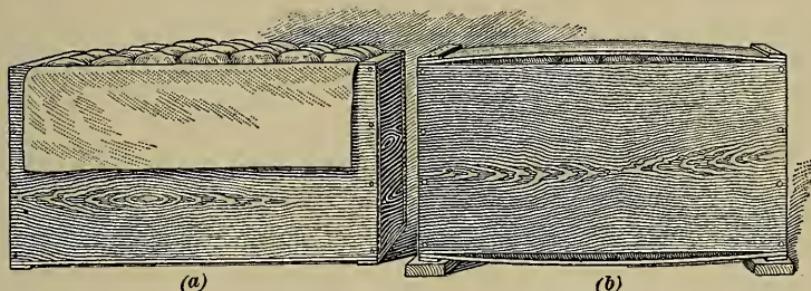
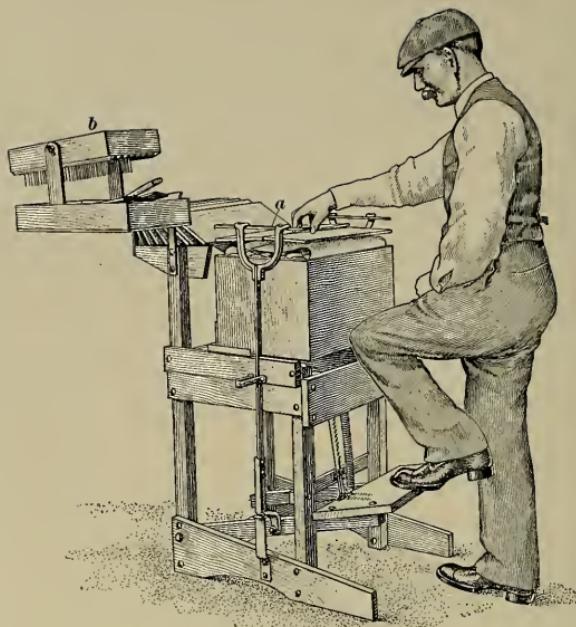


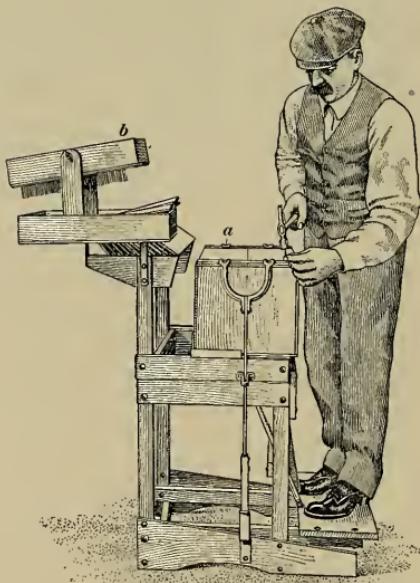
FIG. 33

ends at the top of the box, and about $1\frac{1}{2}$ inches higher than the side at the middle of the box, as shown in Fig. 33 (a). The box, when nailed, will then bulge at both top and bottom, as shown in (b). In order that the proper bulge may be secured it is necessary that the second, third, and subsequent layers be slightly higher at the center than at the ends. This is done by choosing slightly larger apples, or if the apples are oblate, by turning some of them on the side.

In the case of very large apples it is sometimes difficult to get them to come flush with the ends, and to avoid crushing the fruit a cleat is nailed on top of the end of the box and the cover placed above this cleat. The Hood River Apple Growers Union, of Oregon, gives the following instructions about this matter to its members:



(a)



(b)

FIG. 34

"Packers should pack apples so that they will not be above the top of the box at either end. Growers will be allowed to refuse to nail a box unless so packed. If absolutely unavoidable in very large apples, the grower will be sure to put on cleats under the lid at both ends."

To facilitate the nailing of covers on the boxes where a large number are packed, some kind of a nailing press that will hold the box securely while the cover is being nailed is necessary. Box presses for this work can be purchased from dealers in orchard supplies.

Fig. 34 shows a desirable form. When the box has been filled and is ready for nailing, it is placed on the press, and the boards of the cover are placed on the top, as shown in (a). Cleats are then placed across the ends and the clamps *a* are forced down on these cleats by pressure on the foot-lever. The cleats are then nailed as shown in view (b), after which the clamps are released and the box is removed from the press. The nails are held in the box *b*, where they are accessible to the one doing the nailing.

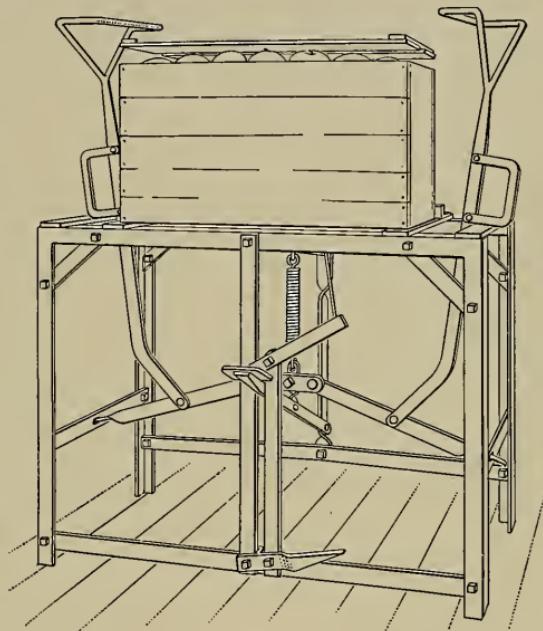


FIG. 35

In Fig. 35 is shown a press that is constructed of steel. The operation of this press is similar to that of the press just described, except that it is not necessary for the nailer to bear down on the foot-lever while the nailing is being done, the press locking itself until released by the lever shown at the bottom of the illustration.

23. Packing of Apples in Baskets.—When apples are being packed in bushel baskets, a basket is filled about half full of fruit and is then racked slightly to level the pack. The basket is next filled to within a few inches of the top, and is again racked, this time a follower being used. The package is next faced by arranging the top apples in a level layer. This layer should extend above the edge of the basket for an inch or so, the exact height depending on the height of the rim of the cover. In order to give an attractive appearance, the apples of the face should be of uniform size and color. After the face has been completed, the cover is put in place and fastened. If the type of cover illustrated in Fig. 20 is used, a nail placed in the center of the strip that passes through the handle will keep the cover in place.

STORING OF APPLES

24. The fact that apples, especially those of fall and winter varieties, can be kept for several months in storage before being used, very much lengthens the period during which this fruit can be consumed. Facilities for the storage of apples are almost indispensable, so far as the grower is concerned, for with them he is enabled to hold the fruit at times when there is a plentiful supply on the market and to dispose of it when the supply becomes less. One advantage of apple orcharding over the growing of many other kinds of fruits is the fact that the apple keeps well in storage.

It is the nature of all fruits to ripen and then to disintegrate. The ripening process does not take place as rapidly at low temperatures as at high; therefore, the purpose in the storing of fruit in cold places is to prolong the ripening process. In the case of some varieties, ripening cannot be greatly prolonged; in the case of others, it can be retarded so that the fruit will keep in storage for as long as 2 years.

The best temperature for storage rooms is the lowest it is possible to obtain without freezing the fruit. Experience has demonstrated that for apples this temperature is from 31° to 33° F.; at lower than 31° F. there is danger of apples freezing. It is important that apples be placed at a low temperature

as soon as possible after they are picked; if left for a few days in the orchard, especially if the weather is hot, they may ripen more than during a month or two in storage. The maturity of the fruit too, has something to do with its keeping quality in storage. Overripe fruit will disintegrate sooner than fruit that has just reached full development and attained good color. Closely associated with the length of time apples will keep in storage is the length of time they will keep when taken out of storage. If they have been stored for a long time, they will usually keep for but a short time after taken out of the storage room. Apples held in storage for a short time keep longer after they are taken out of storage, of course, than those kept in storage for a longer time.

Varieties of apples vary greatly in the length of time they will keep in storage. Ben Davis, Mann, and some of the Russets are good keepers; Wealthy and Wagener will keep only until about January or February. Some varieties like the Jonathan, for example, are poor keepers in the cellar or at ordinary temperatures but are good keepers in cold storage; occasionally a variety, the York Imperial for instance, does better in cellar storage than in cold storage. It has been found, also, that a variety grown in a northern latitude or at a high altitude has better keeping qualities in storage than the same variety grown farther south or at a lower altitude.

Fruit of good quality is necessary for successful storage. Apples that are partly decayed are sure to spoil if kept for any length of time, even at a low temperature, and wormy or otherwise defective fruit is not worth the cost of storage. Apples should be carefully sorted, therefore, before being placed in storage, and only those of the best quality reserved for the storage room; the second grade, or inferior fruit, should be disposed of at once for what it will bring.

After apples have been placed in storage they should be undisturbed until ready to be moved, for excessive handling seems to injure the keeping quality.

25. Commercial Cold Storage.—In cities and towns apple growers can generally find commercial cold-storage houses

in which space is for rent. When contemplating the renting of space, a grower should ascertain whether the storage house in question has stored apples successfully in the past, for often plants are not conducted primarily as storage places for fruit, but rather for meat, eggs, and butter. These products require a lower temperature than fruit does; and if separate rooms of the proper temperature are not maintained for fruit, it is likely not to keep satisfactorily.

The price for commercial storage space varies in different localities. The usual rate for bushel boxes or baskets is from 15 to 25 cents from picking time to April 1, and for barrels is from 25 to 60 cents. There is usually an additional charge per month for fruit left in storage after April 1.

26. Farm Cold Storage.—Growers whose orchards are at a considerable distance from market or shipping stations, or who cannot find convenient or cheap facilities for storing fruit in commercial storage houses, often find it advantageous to maintain a storage house on the farm. Such houses can be used to hold the fruit temporarily, or if they are well constructed, during the whole season. Individual conditions will, of necessity, determine whether or not such a house is required or is practicable.

Ice is often used as the cooling agent in storage houses of farms, but the principal disadvantage is the fact that it usually must be kept from winter until the next fall before being used in the fruit house. Therefore, unless ice is plentiful and cheap, ice storage is not especially economical. When used in fruit-storage houses, the ice is placed in a room above the one where the fruit is stored, and cold air from this room is conducted by means of shafts to the lower part of the storage room and the warm air is conducted from the storage room through shafts that open at the roof. All of the walls should be built with dead-air spaces for insulation.

27. In the northern part of the United States and in the provinces of Canada, storage houses that are cooled by ventilation are much used. This plan of cooling is economical and if properly managed is very satisfactory. The cold air is admitted

near the bottom of the room, and is, of course, from the outside; the warm-air outlets are in the ceiling. The number of cold-air intakes and warm-air outlets will, of course, vary with the size of the building, but they should be ample to secure a good circulation of air when desired and should be provided with opening

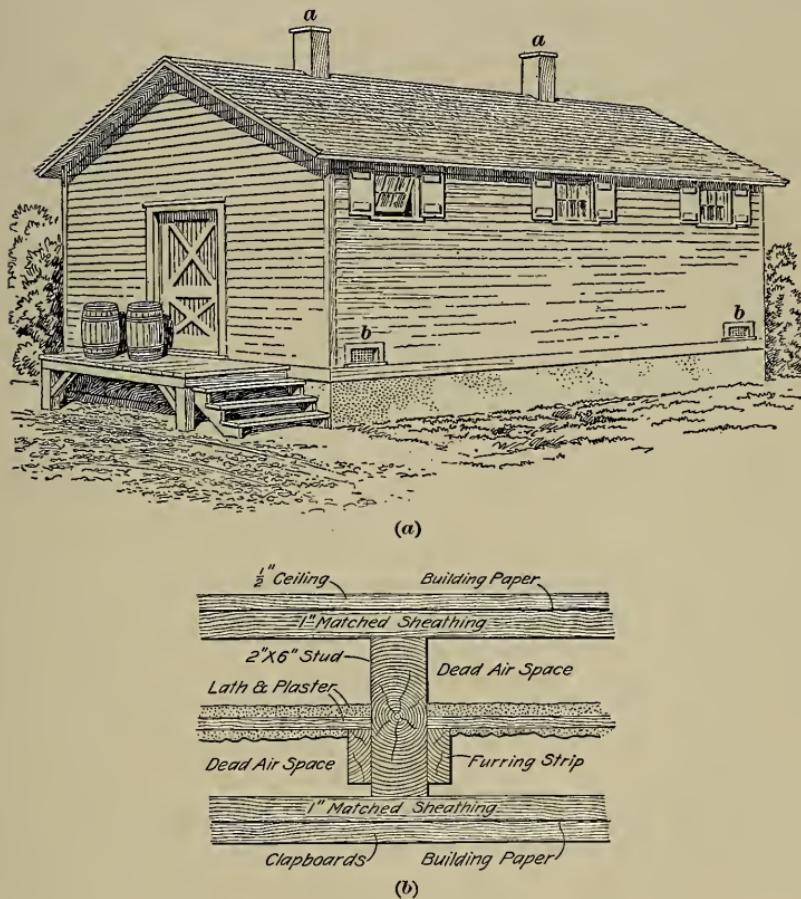


FIG. 36

and closing devices that can be operated at will. Several cold-air intakes are preferable to one, and if the room is longer than, say, 14 to 16 feet, it is advisable to have two outlet ventilators in the ceiling. For a room 12 ft. \times 12 ft. or 12 ft. \times 14 ft., one outlet will be sufficient. The walls should be made with at least one dead-air space, and two such spaces are preferable. These

provide against outside changes of temperature and are absolutely necessary for proper insulation.

28. In Fig. 36 (*a*) is shown a well-designed storage house of the type cooled by ventilation. It is 24 feet long, 14 feet wide, and 10 feet high at the ridge. The walls are made with two dead-air spaces. Two ventilators *a* and four intakes *b*, two in each side, are provided. In (*b*) is shown the wall construction of the house. The temperature changes in the house are secured by opening and closing the intakes and outlets. For several

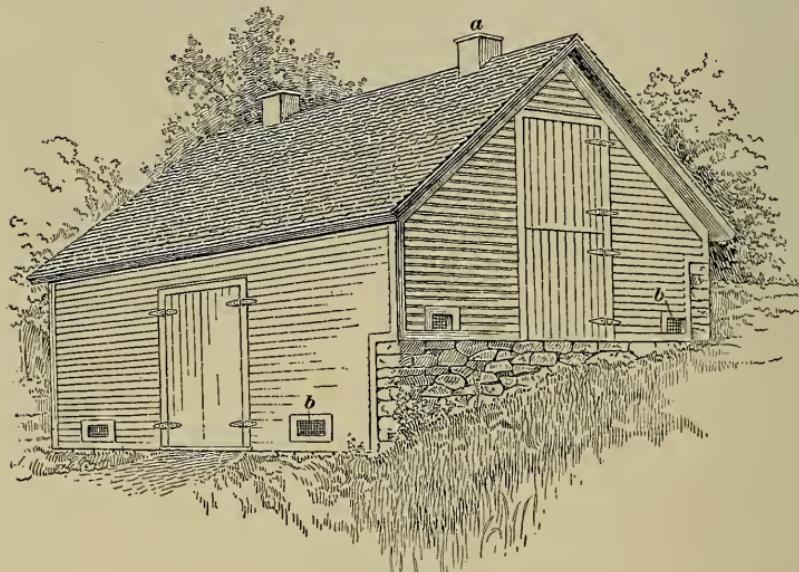


FIG. 37

days before the house is to be used, the doors and windows are closed, and on cool nights the air ducts are opened and in the morning before the sun gets high they are closed. This tends to cool the air on the inside. If a particularly cool day occurs, the doors and windows are opened. After the fruit has been placed in the house, the temperature is watched and the ventilators and intake ducts opened and closed accordingly. When freezing weather occurs, the doors and windows are opened during the warmest part of the day, or if necessary, oil heaters are used to reduce the temperature.

In Fig. 37 is illustrated a frame storage house of sufficient size to hold about 1,500 bushels of apples in bulk. The house is 16 feet wide and 24 feet long, outside measurements, and has 10-inch double walls that are packed with sawdust. Ventilation

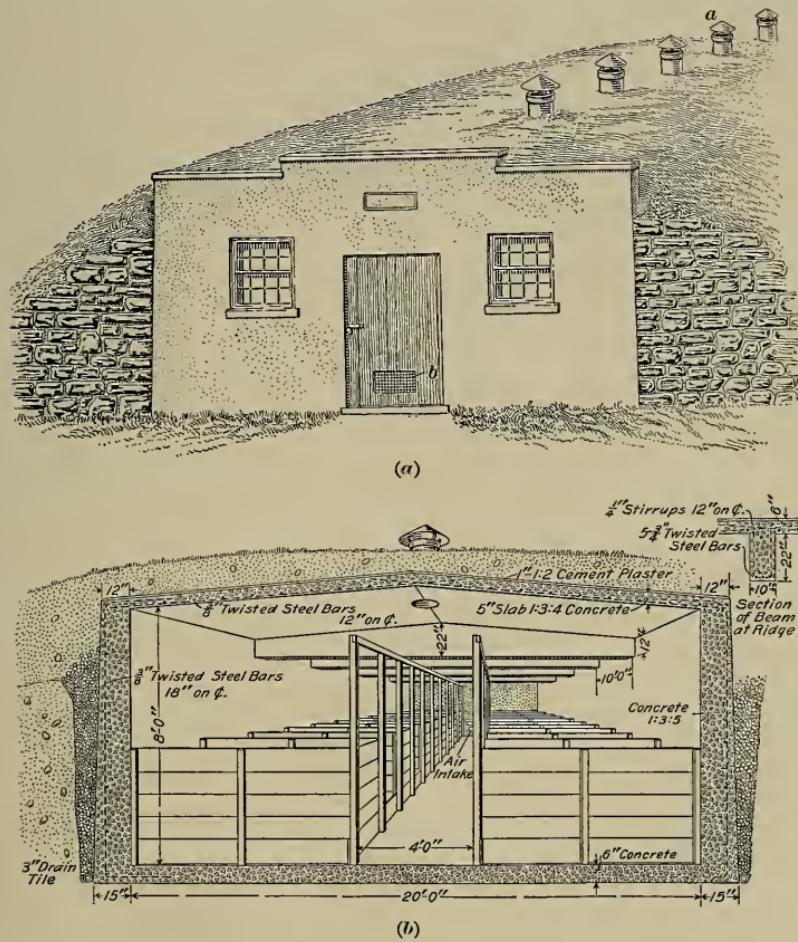
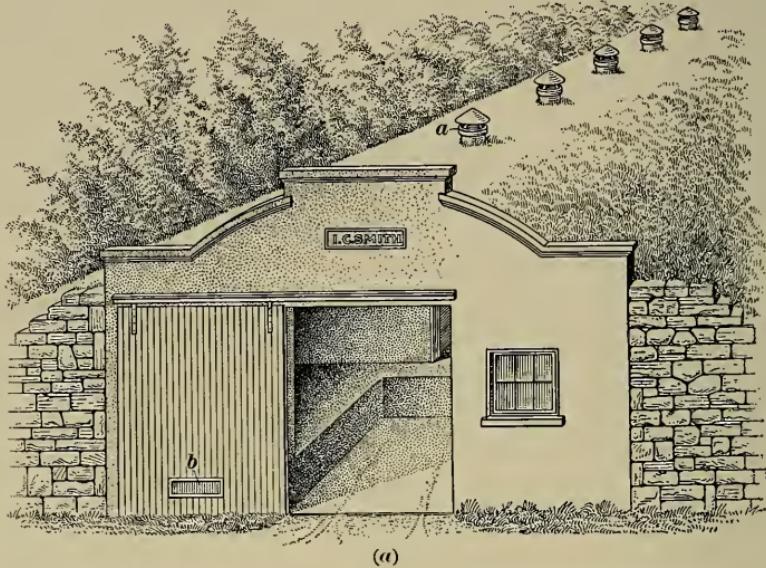


FIG. 38

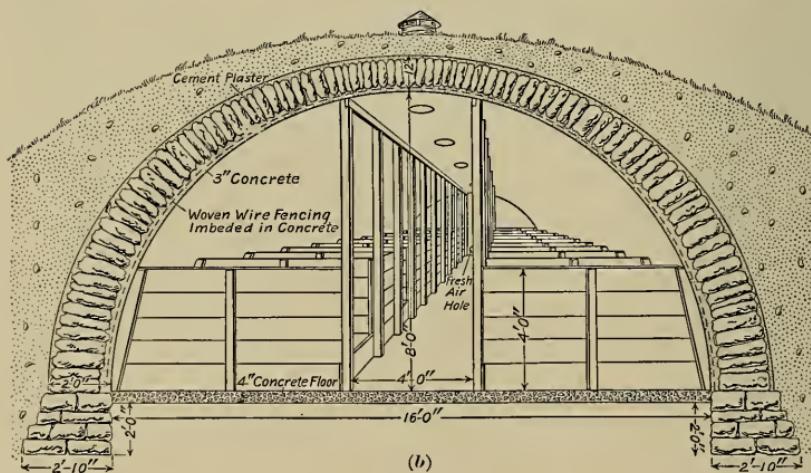
is secured by means of ventilators *a* and intake chutes *b*. The doors at the side and end are also used for ventilation.

A concrete storage house that is suitable for use where from about 6,000 to 7,000 bushels of apples are stored annually is shown in Fig. 38. In (a) is shown the exterior appearance of the building. Four roof ventilators and two air intakes are provided.

The first four pipes in the roof, or those back to *a*, are ventilators; the pipe at the back is an intake chute that extends downwards through the rear wall to a point near the floor. The other intake



(a)



(b)

FIG. 39

is shown at *b*. The dimensions and method of construction are shown in view (*b*). The apples are stored in bins arranged as illustrated. A house of this kind can be built for from \$800 to \$1,200, depending on the cost of material and labor.

In Fig. 39 is shown a storage house that is constructed of stone, concrete, and cement plaster. As in the house just described, there are four roof ventilators *a*, and two intakes, the pipe at the back being an intake, as in the house shown in Fig. 38; the other intake is shown at *b*. In view (*b*) is shown the dimensions and method of construction of the house. The front of the house is constructed of concrete and over the roof is placed about 1 foot of earth. The interior is divided into two rooms, the front one being used as a packing room and the rear one as a storage room. The front room is 20 feet long and the rear room is 60 feet long. The apples are kept in bins, arranged as shown in the illustration. The storage room will hold between 6,000 and 7,000 bushels of apples. Such a house can be built for about from \$1,200 to \$1,500.

When a good cellar is available, winter apples may be kept there in fairly good condition until January or February and often later. A cellar for apples must be frost-proof but at the same time it should be cool and somewhat moist.

29. When comparatively few apples are to be stored, they can be satisfactorily taken care of in pits dug in the ground. The size of the pit will depend, of course, on the quantity of fruit to be stored; as a rule, from 30 to 50 bushels is about as large a quantity as should be stored in one pit. The excavation may be about 3 or 4 feet deep, and a trench should be dug around it to provide drainage. A small quantity of straw is piled in the pit, the fruit is piled on this straw, then a layer of straw is placed over the fruit, and boards are placed over this. It is well to make the pile cone-shaped and to arrange a bottomless box of wood from the top to the outside air to provide ventilation. Above the straw and boards a thin layer of earth is piled, and as the weather becomes colder more earth is added. Apples will keep very well in such a pit, especially if the fruit is not often disturbed. Perhaps the best way is to take all of them out at the same time; however, it is possible to open the pit occasionally and remove a few apples, and still have the others keep fairly well.

MARKETING OF APPLES

RETAIL MARKETING

30. When a grower sells apples at retail direct to consumers or sells to retail merchants who, in turn, sell to consumers, he has a personal acquaintance with his customers and is thus enabled to cater to their individual demands. This acquaintance gives him an opportunity to sell varieties that, although they have good qualities, are not well known on the general market. On a local market small quantities of fruit can be disposed of, and, as a rule, the margin of profit on the individual package is likely to be greater than if the fruit is sold at wholesale. In addition, competition is likely to be less when fruit is sold at retail than when it is sold at wholesale, as special customers that will buy the grower's fruit year after year may be secured, whereas in the wholesale market the fruit is in competition with large quantities of the same kind and quality. Often, too, a grower who sells apples at retail can secure the profit that otherwise would go to commission men and wholesale merchants. In this case, however, he must, in a measure, do the work of these men, bearing the cost of collections, loss in bad debts, cost of delivery, etc. The grower who is selling apples to private customers can often save the price of the fruit package by delivering in bags, used boxes, crates, etc., leaving the consumer only the fruit.

A grower selling at retail must keep in touch with the local demands for fruit and the prices as shown by market quotation, and make his prices accordingly. He is salesman as well as grower, and his success will depend largely on his ability to handle each operation. A good grower may be a poor salesman, and a poor grower a good salesman; in the case of either success may not be attained. It is when a grower is good both at the production end and the selling end that he is likely to be a success at selling at retail.

WHOLESALE MARKETING

31. Apples sold on the wholesale, or general, market are handled in large quantities and the margin of profit on each package to the grower is usually smaller than if sold at retail. The fruit is generally handled by a commission man or other middleman, and hence the grower does not come into direct contact with the consumer. When apples are grown for the wholesale market, only a few varieties should be offered for sale and these should be of the standard varieties that are quoted on the general market. As a rule, only first-class fruit should be offered at wholesale, and it should be well packed and be in the type of package generally handled on the particular market to which it is shipped. Careful grading of the fruit is also a prime requisite, as the appearance of the produce has much to do with the price it will bring.

A grower who sells at wholesale must study the market demands, for different markets desire different varieties of fruit. Boston, Philadelphia, New York, Chicago, St. Louis, and, in fact, all large markets differ somewhat as to market demands, and thus it is to the advantage of a grower to find out which market is likely to pay the best price for the variety or varieties he has for sale.

32. A grower usually has several methods by which he can dispose of his crop at wholesale. A buyer may come to the orchard and offer a certain amount for the crop as a whole, or may offer to take the crop at so much a barrel or box for the apples packed, or may contract for the fruit picked and delivered to the packing tables. Again, the grower may pack the fruit himself and ship it to commission men at market centers who will dispose of it and return the grower the balance due after they have deducted commissions and other expenses.

Whether to sell direct to buyers or through commission men will depend largely on local conditions and on the grower's knowledge of market prices and market demands. No general rule as to which method is the better can be given; each grower will have to solve this problem for himself.

When about to sell a consignment through a commission man, the grower should find a dealer who has the reputation of being thoroughly honest and who knows the demands of the trade in the market in which he sells. Such a dealer is in a position to give the grower advice that, if heeded, will be the means of making him additional profit. All apples shipped to the commission man should be graded and honestly packed; a few poorly graded and dishonestly packed consignments will so injure the reputation of a grower that when his fruit comes to the market it is looked on with disfavor. When a commission man is found to be thoroughly reliable and satisfactory, he should be retained year after year. If a different commission man is retained each year it will be necessary for each one to learn the merits of the grower's fruit.

33. Cooperative selling of apples is perhaps the ideal way of disposing of them, provided all members and officers of the selling organization do their work faithfully and well. The greatest success in cooperative selling is attained when the fruit is put on the market under a brand that becomes known as a guarantee of an absolutely honest grade of goods. Such goods will have a reputation in the market that will cause them to sell for prices higher than is generally received for the same grade of produce. Cooperative selling of a certain brand of apples is, as a rule, better than the selling of a brand by an individual grower, for but few growers have fruit enough for sale annually to impress a market to an appreciable extent.

34. Many apples are shipped annually and sold at wholesale to foreign markets, principally to England. Many of the boxed apples from the West, including the Spitzenburg, Delicious, and Newtown Pippin, find a ready sale in England, as do the Northern Spy, King, Greening, Baldwin, Fameuse, and Mann of the Eastern States and Canadian Provinces. Apples that are to be shipped to foreign countries should be very carefully graded and securely packed, as only good fruit that reaches its destination in good condition will sell readily.

As a large part of the apples exported go to Great Britain, it is well for a grower to know something of selling methods at

Liverpool, Glasgow, and London, the principal ports in Great Britain for the sale of apples. The fruit, as a rule, is sold at auction. Each shipment is kept separate and before the auction any buyer may go among the packages and open as many as two of each lot. Then at the auction, one package is opened and bids are made on the whole shipment or on any part of it. Thus, it may be seen that to be sure of the purchaser opening a package of good fruit, the shipment should be uniformly good.

In Great Britain, fruit is sometimes sold by shippers direct to dealers or to private salesmen, the purchaser thus saving the commissions charged at the auction. This method of selling is especially desirable for growers or associations that can guarantee their fruit to be of a uniformly good grade.



FIG. 40

MISCELLANEOUS INFORMATION ABOUT MARKETING

35. Labels for Apple Packages.—Experience has shown that the use of appropriate labels on apple packages is a paying proposition, especially if the fruit is of one of the best grades.



FIG. 41

A label serves to advertise the products of an orchard, and if it is always used for fruit of uniform grade, it guarantees, in a way, to the commission man and the purchaser that the fruit in the package is of good quality. Consumers soon learn to recognize and call for labeled fruit from certain orchards, and this fact has been worth much to certain growers. A label should be neat, attractive, and suggestive of the quality of the fruit. In Figs. 40 and 41 are shown reproductions of lithographed labels used for boxed fruit grown in the Pacific Coast States. Fig. 42 shows the forms of label

used for boxes, baskets, and barrels by a fruit company in Pennsylvania. In Fig. 43 is shown an inexpensive but attractive label used by an Ohio grower for a particular variety; the original from which this cut was made is printed on pink

paper with green ink and the effect is very pleasing. In Fig. 44 is illustrated a label used by a Pennsylvania company for boxes of fancy fruit. It is printed in red ink on white paper, and is very attractive. Fig. 45 shows a label for barrels used by an orchard company of Maryland. The small cut in the center

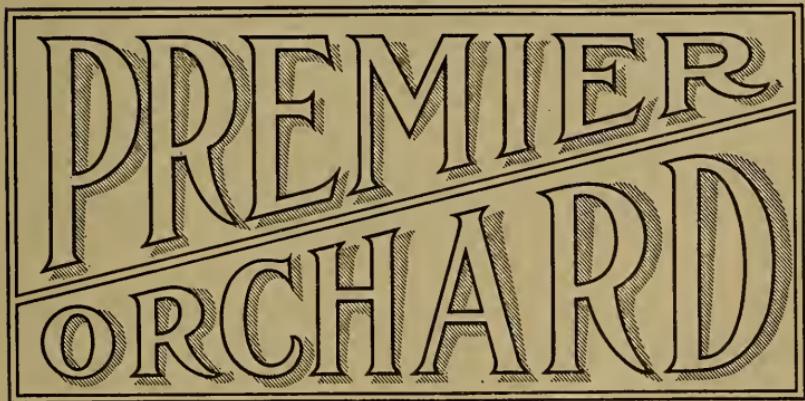


FIG. 42

of this illustration is a half-tone engraving showing an orchard scene. The half-tone is printed in black ink and the rest of the label in blue ink, white paper being used. The label is sufficiently large to cover the entire head of a barrel.

36. Keeping in Touch with the Market.—Whether a grower sells to a commission man or to retailers or to consumers

direct, he should keep informed about current prices of fruit. The telephone and daily market reports, both local and general, will aid in this matter. If his fruit is sold by an association this work



FIG. 43

will, of course, be done for him. As late fall and winter varieties of apples can be kept for a time in cold storage, the grower or association can hold the fruit until the market seems right for a sale. In the case of summer and early fall varieties, storage is not so much of a help, but even with most of such varieties the fruit can be kept for a time. In selling summer varieties on a local market, a grower should watch the shipments of peaches and avoid sending a large consignment of apples to market when peaches are there in abundance, for consumers are more likely to purchase summer apples when peaches are scarce than when plentiful.

37. Maintaining the Price of Apples.

On a local market, and on a wholesale market, when possible, it is well to ask a good price for first-class apples. Consumers

are, as a rule, willing to pay well for good fruit, and the grower who gives his time and energy to the production of such fruit should have just compensation.

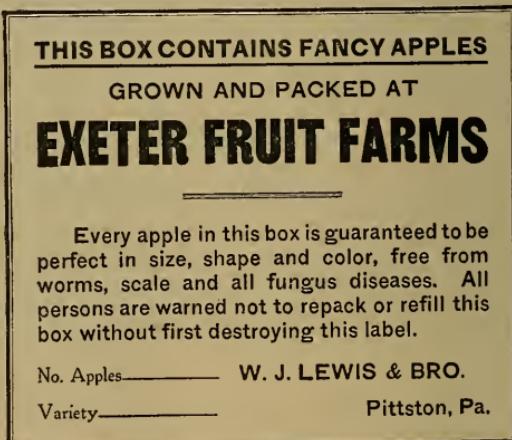


FIG. 44

38. Use of Clean Packages.—All barrels, boxes, baskets, and crates that are to be retained by the consumer should be new and clean; it is poor business to place apples in soiled packages and offer them to a customer, even at a slightly lower price than for fruit in a new package. Attractiveness counts for much; it creates a desire for the fruit and thus makes it more salable.



FIG. 45

39. Importance of Careful Grading and Packing. Whether fruit is to be sold in large or small lots, careful grading and honest packing are essential for the securing of good prices. Grading to size and color gives a more uniform and hence a more attractive appearance, and grading to quality insures that a package will keep well, and thus not be a disappointment to the consumer. Honest packing is a means of securing satisfied customers, which are necessary to the success of any form of merchandising. If customers are satisfied they will ask for apples from the grower's orchard when they wish to purchase fruit again.

40. Importance of Honest Labeling.—Honest labeling of packages is a matter of business that the grower cannot fail to neglect. The marking of a barrel No. 1 when it should be a No. 2, or a box fancy when it should be choice, is poor business, for it will be the means of dissatisfying customers and, if discovered by wholesale buyers, will result in a small check being returned to the grower.

41. Advertising of Fruit.—The grower who sells his fruit on a local market is, in a sense, a merchant and as such should advertise his product. This he can do by practicing careful grading, honest packing, honest labeling, and by using clean and attractive packages. In addition, he should advertise in local newspapers or in other such mediums of publicity. An advertisement in a local paper stating that a certain grower offers apples for sale and that the apples are all sound and free from defects, is almost sure to be a good business move. Advertising by means of attractive labels, as previously explained, and by attractive displays of fruit where consumers will see them, are good methods of attracting attention. Fruit growers' associations make extensive use of such means; in fact, some associations employ advertising managers whose business it is to see that the public becomes acquainted with the brands and fruit of the association.

UTILIZATION OF INFERIOR APPLES

42. The utilization of inferior apples is an important problem connected with marketing of the products of an orchard. In fact, the working up of otherwise waste apples into some salable form is often the means of bringing considerably increased profits to a grower. Among the products that can be made from culls are evaporated apples, canned apples, apple butter, apple jelly, apple cider, and apple vinegar.

43. Evaporated Apples.—One of the principal products that can be made from second-grade fruit is evaporated apples. Experience has proved that fall and winter apples give a better yield and quality of dried fruit than do summer apples. The

average yield of evaporated apples is from 5 to 7 pounds per bushel of fresh fruit. In most sections where apples are produced abundantly, commercial evaporating houses are to be found where the grower can dispose of apples not suitable for packing. These establishments generally evaporate fruit more cheaply than a grower can, and therefore, where such a house is conveniently near the orchard, it usually pays the grower to sell his culls rather than to evaporate them himself. However, there are on the market small evaporators that can be used on the farm, and where no commercial establishment is near, they can be made an effective means of preparing culls for market. One of the simplest evaporators for home use is illustrated in Fig. 46. It is simply a box that is placed on top of a kitchen range or stove. The fruit to be evaporated is placed in the drawers, or trays, *a*, which have galvanized wire screen bottoms, and the heat from the fire in the stove does the evaporating. This evaporator can be used, also, on a gas, gasoline, or kerosene stove.

In Fig. 47 is shown an evaporator with a furnace attached. The fruit, when prepared for evaporating, is placed in the trays *a*, which are then put in place in the evaporator. The capacity of the machine illustrated is from 30 to 50 bushels of apples per day, but machines of this type that range in capacity from 4 to 150 bushels per day can be purchased.



FIG. 46

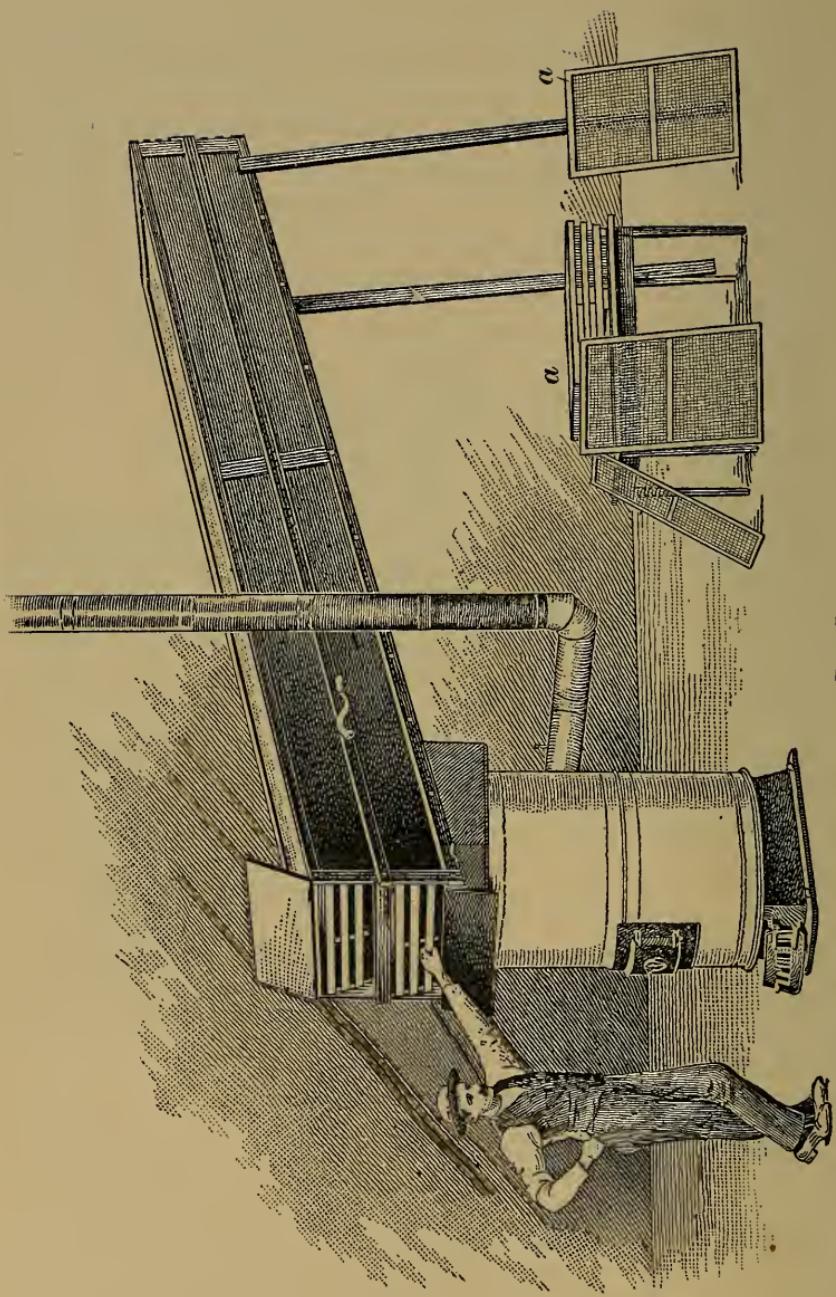


FIG. 47

In Fig. 48 is shown another form of evaporator with a furnace attached. This evaporator is made of metal and can be purchased in sizes ranging from 3 to 30 bushels per day. The evaporator illustrated has a capacity of from 5 to 7 bushels per day.

Evaporated apples are placed on the market whole, in quarters, in sixths, or sliced. Perhaps the commonest method is to market them in slices a quarter of an inch in thickness, the cut being made across the apple at right angles to the core. Mechanical parers, corers, slicers, quarterers, etc. are on the market. Small machines that work by hand or foot power can be had and their use is recommended whenever a grower has enough fruit to evaporate to make their use practicable.

After the fruit has been pared and cored and, unless evaporated whole; cut into quarters, sixths, or slices, it is treated for a short time to the fumes of burning sulphur, which prevent the discoloring of the pieces by preventing oxidation. Special appliances, known as color setters, in which the sulphur is burned, are supplied with large evaporators. When use is made of the cook-stove type of evaporator, a small piece of sulphur the size of a pea is placed on the top of the stove. This sulphur soon ignites and the fumes prevent the discoloration of the fruit in the trays above.

Following the color setting, as the process just referred to is called, the fruit is placed on trays in the evaporator and heated

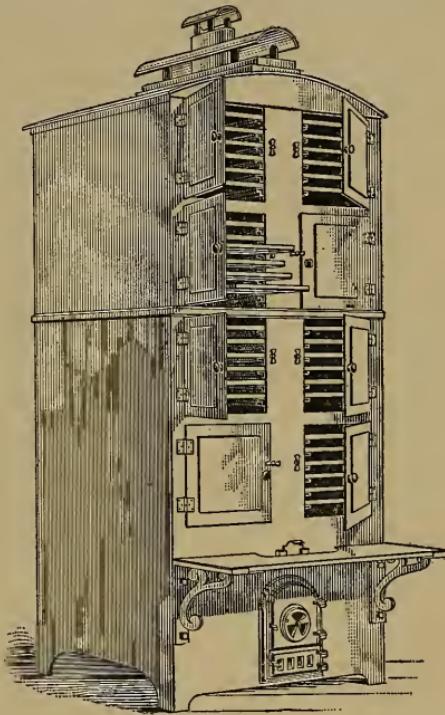


FIG. 48

until a certain amount of the moisture in the fruit has been evaporated. The length of time necessary for evaporation will, of course, vary with the heat and with the size of the pieces. No general rule as to time can be given. In this matter the grower should be guided by the directions that come with the machine. The condition of the fruit is, however, somewhat of a guide as to when the fruit is sufficiently evaporated. When a handful of pieces is squeezed into a mass in the hand they should be springy enough when pressure is released to separate and show no signs of sticking together. Moisture should not be in evidence on the surface of the pieces, nor should juice show when one of the pieces is cut or broken.

44. Canned Apples.—Most of the canned apples on the market are put up by commercial canning factories. If a grower is near an establishment of this kind he can often get a fair price for his second-grade apples. Small canning outfits suitable for use on farms are on the market at prices ranging from \$100 to \$300 or more, depending on the size, capacity, etc. They can be used for peaches, small fruits, tomatoes, and other vegetables as well as for apples. Whether or not it will pay a grower to own and operate a small canning outfit will depend largely on the quantity of fruit and vegetables that he will have for canning and the availability of labor.

45. Apple Butter.—There is considerable demand on the market for home-made apple butter, and if a grower can work up a special trade for this product he is likely to find that apple-butter making is a profitable way to utilize apples that would otherwise be wasted.

46. Apple Jelly.—The making of apple jelly at home for sale commercially is not generally conducive to profit, as the grower must compete with large manufacturers. If, however, a grower can make jelly for a special trade and be sure of the sale of the product at a fair price, it is possible to make this a profitable method of disposing of inferior fruit. Small outfits for the making of jelly can be purchased from dealers in canning supplies.

47. Apple Cider and Apple Vinegar.—The poorest apples from the orchard can be made into cider and used as such, or the cider can be allowed to turn to vinegar. The making of cider is a business apart from the growing of apples, and usually a cider mill can be found in any community where business warrants it. The profits from apples made into cider are small, and if much time is required to get the fruit to the mill, it is often more profitable to feed such apples to the live-stock of the farm.

PEAR CULTURE

(PART 1)

INTRODUCTION

1. The pear-growing industry of the world, although very old, has, from the beginning, been subject to more or less adverse conditions that have operated to discourage extensive production. In the early writings of the Greeks and Romans, numerous references are made to pears and to pear culture, but emphasis is placed on the fact that the pears were of very poor quality and could be used only to make beverages. In English and American horticultural works of the latter part of the 18th century and the first of the 19th century, as much space is devoted to pears as to apples, but there is a tone of discouragement in the discussion of pears, owing to the fact that fire blight was becoming prevalent and wiping out the industry. Although a great many varieties of pears were described at that time, some works describing as many as seven hundred, few were of value for dessert use, the pear being grown primarily for cooking purposes and for the production of a cider known as perry. About the middle of the 19th century, considerable interest was aroused in the pear as a result of the introduction of certain improved varieties. However, from that time to the present, fire blight has been more or less prevalent and this, together with various other conditions, has discouraged many persons from attempting to raise pears.

2. With the exception of a few states, pear growing in the United States has been on the decline for several years. In the northern tier of states, including certain of the New England

States, New York, Michigan, and others, the pear-growing industry seems to be holding its own, and, in some cases, is slightly on the increase. In the Southern and Middle States the industry is on the decline. In the states of the Pacific slope, particularly Oregon, there has been an increase in the industry, but in certain of the Rocky Mountain States, like Utah and Colorado, a decrease has occurred. A summarized statement of the status of pear growing in various states arranged alphabetically, follows.

Alabama: Pear growing is at a standstill in Alabama, due chiefly to fire blight. The principal varieties grown in the northern part of the state are Kieffer, LeConte, and Garber; in the southern part of the state Magnolia and Golden Russet are the chief varieties.

Arizona: In Arizona the industry is probably on the increase, although fire blight has been very serious in some sections. The principal varieties are Bartlett, Winter Nelis, and Kieffer. Other varieties that do well are Clapp Favorite, Flemish, Howell, LeConte, Anjou, and Seckel.

Arkansas: Few plantings of pears are being made in Arkansas at the present time because of the prevalence of fire blight. Kieffer, Garber, and similar varieties are the principal ones grown.

California: For years California has been the leading pear-growing state. From the early eighties to the beginning of the present century an enormous development of the industry took place. During the last decade, however, fire blight has done serious damage. This is doubtless due to the fact that growers failed to take proper steps toward controlling the disease. More difficulty has been experienced in fighting the blight in irrigated regions than in those where irrigation is not practiced.

Colorado: In Colorado pear growing is confined to the western slope. Fire blight is very severe, rendering the industry unpopular. The principal varieties grown are Bartlett, Kieffer, Anjou, Flemish, and Seckel.

Connecticut: There are very few pear orchards in the state, the total acreage of commercial orchards being estimated at

not more than 50 acres. A few pears are grown in home orchards. The chief varieties grown in the state are Bosc, Anjou, and Seckel.

Delaware: The growing of Kieffer pears in Delaware is rather extensive. New plantings of this variety are being made. Recently, however, fire blight has attacked the Kieffers and the industry seems to be threatened. There are a few plantings of Bartlett, Anjou, and Lawrence.

Florida: It is probable that the growing of pears will never become a commercial industry in Florida. Pear growing in the state is on the decrease, due to ravages of fire blight. The most popular varieties grown are Kieffer, Garber, and Cincincis.

Georgia: The industry in Georgia has never been profitable. Many orchards have been ruined by fire blight, which seems difficult to control. The Kieffer is the chief variety grown.

Idaho: The industry is not as great in Idaho as it was formerly, but some interest is being manifested at the present time in the planting of varieties such as Bartlett, Anjou, Winter Nelis, Flemish, and Howell.

Illinois: The industry in Illinois is thought to be decreasing rapidly, due to ravages of fire blight. The Kieffer is still grown commercially in some sections.

Indiana: The industry is on the decline in Indiana, due to prevalence of fire blight. The most popular varieties grown are Bartlett, Clapp Favorite, Tyson, Flemish, Sheldon, and Seckel.

Iowa: Pears are little grown in Iowa. Knoxville is the only place in the state where the market is supplied by a local orchard. A few growers are making a success with such varieties as Kieffer, Bartlett, and Flemish.

Kansas: Pear growing is at a standstill in Kansas. The principal varieties grown are Kieffer and Garber.

Kentucky: Pears in small quantities are grown in all sections of Kentucky, but there are very few commercial orchards. Fire blight has done serious damage in the state. The principal varieties are Bartlett, Kieffer, Seckel, and Garber.

Maine: Pear growing in Maine practically amounts to nothing. The southwest counties grow a few pears, the varieties being Bartlett, Clapp Favorite, Flemish, Seckel, and Vermont Beauty.

Maryland: In Maryland pear growing is not increasing but is thought to be holding its own. A considerable acreage in the state is planted to Kieffers. Other varieties grown to a limited extent are Bartlett, Anjou, and Clairgeau.

Massachusetts: In Massachusetts pear growing is on the increase at the present time, but has decreased greatly in the last 50 years. The industry shows some signs of reviving. The principal varieties grown commercially are Bartlett, Seckel, Bosc, and Anjou.

Michigan: Pear growing is thought to be slightly on the increase in the state. The Bartlett is the principal variety grown.

Missouri: Pear growing in the state is thought to be at a standstill. The Kieffer is the principal variety grown, but a few plantings of Garber, Anjou, and Seckel are found. Recently, it is said, the Lincoln variety has come into favor.

Montana: The industry amounts to little in Montana. Fire blight has been serious.

Nebraska: Pear growing as an industry is not considered important in Nebraska, there being only a few commercial orchards. The Kieffer is the principal variety grown; other varieties sometimes found are Bartlett, Sheldon, Seckel, and Flemish.

New Mexico: The growing of pears is on the increase in New Mexico, several valleys in the state giving promise of producing excellent crops. Fire blight has never been serious. The principal variety is the Bartlett.

New York: According to a report of the Geneva Experiment Station, pear growing in New York is holding its own, with possibly a slight increase. The Cornell Experiment Station reports that the industry is slightly on the increase. The most popular varieties are Bartlett, Seckel, Kieffer, Clapp Favorite, Sheldon, Bosc, Anjou, Clairgeau, and Winter Nelis.

Oklahoma: Little is known of the true status of pear growing in the state; it is thought, however, that comparatively few pears are grown. Fire blight is the most serious drawback. The Kieffer is the favorite variety, Garber and Seckel being grown sparingly.

Oregon: From all indications Oregon will soon supplant California as the leading pear-growing state. There is an enormous area and a splendid opportunity for pear growing in the Rogue River, the Umqua, and the Willamette valleys, and in some of the mountain valleys like the Hood River, it seems probable that pear culture will become much more important than it has been in the past. Pears from the Rogue River Valley have topped the markets of the world in both quality and selling price. Oregon fruit growers are being advised to specialize to some extent on pear growing.

Pennsylvania: Pear growing has been on the decrease in Pennsylvania for several years, although at the present time there are indications of a renewal of interest in the industry. The decrease in pear growing in the state is attributed to ravages of fire blight. The principal commercial varieties are Kieffer, Clapp Favorite, Bartlett, Flemish, Seckel, Anjou, and Sheldon.

Rhode Island: In Rhode Island the growing of pears is confined almost entirely to home orchards, there being practically no commercial orchards in the state. The principal varieties are Clapp Favorite, Bartlett, Sheldon, and Seckel.

South Carolina: It is believed that pear growing is on the increase in South Carolina and that the industry may become of some importance. The principal varieties grown are Bartlett, Kieffer, Seckel, Garber, and LeConte, Kieffer being the most popular.

South Dakota: Very few pears are raised in the state. The winds are too severe to be favorable to pear growing and fire blight is prevalent.

Tennessee: There is practically no commercial pear growing in Tennessee. A few Kieffers, Garbers, and LeContes are grown in home orchards.

Texas: Very few pears are grown in the old agricultural districts of Texas. At one time the industry was started on

an enormous scale, but most of the plantings have disappeared. Kieffer is practically the only variety grown, although some Chambers and Bartlett plantings are found. It is said that the plantings of the Bartlett are doing well.

Utah: Pear growing is very much on the decline in Utah, due to fire blight. The principal varieties are Kieffer, Flemish, Anjou, Bartlett, and Clapp Favorite.

Vermont: In Vermont pear growing dwindled to nothing about 20 years ago, due to the fire blight.

Virginia: The pear-growing industry in Virginia is probably not increasing. Fire blight has discouraged the growers.

Washington: It is thought that pear growing is on the decline in the state. The principal varieties are Bartlett, Clairgeau, and Winter Nelis.

West Virginia: Pear growing in West Virginia amounts to practically nothing, being confined to a few home orchards. It is estimated that at least 95 per cent. of the pears grown in the state are Kieffers. Other varieties grown on a small scale are Garber, Seckel, Clairgeau, Bartlett, Howell, Lawrence, Mount Vernon, and Danas Hovey.

Wisconsin: There are few if any commercial pear orchards in the state. Kieffer, Flemish, and Seckel varieties are grown to some extent in home orchards.

Wyoming: Pears are being planted freely in the state at the present time. Bartlett, Seckel, and Kieffer are the most popular varieties.

3. Owing to the fact that pear growing is declining in many states and is at a standstill in others, it is obvious that there is no danger of overproduction. Although there may be some seasons when pears of varieties like the Bartlett will not bring desirable prices, on the whole the price will doubtless remain high. It is believed by competent authorities that for the next 20 years, at least, pears will be one of the most profitable fruits to grow. In order to be successful in the business, however, growers must exercise care in the selecting of orchard sites and in managing orchards so as to avoid fire blight. These points will be discussed later.

CLASSIFICATION OF PEARS

BOTANICAL CLASSIFICATION

4. Botanically, the pears that are cultivated in North America for their fruits may be divided into two groups: the *European group* and the *Oriental group*. The pears of these two groups are so widely different that an understanding of each is necessary.

5. **European Group of Pears.**—The European group of pears originated from the native pear of Europe, *Pyrus communis*. Many varieties of this group had their origin in America, but they are, of course, seedlings of the European pear. Examples of these are the Seckel, Lawrence, Howell, Clapp Favorite, Wilder, Tyson, and others. On the other hand, many varieties of the European group have been imported directly from Europe. Examples of these are the Anjou, the Angouleme, and the Bartlett. Pears of the European group have been grown in this country from the time of the earliest settlements. They are noted for their productivity and fine quality; the trees, however, are not as hardy as is desired, being very susceptible to fire blight.

6. **Oriental Group of Pears.**—The Oriental group of pears originated from the native pear of China and Japan, commonly called the sand pear, *Pyrus sinensis*. The sand pear was introduced into America many years after the European pear. The trees of this stock were hardy and productive, and were able to thrive in much warmer regions than those of the European pear. Owing to the fact that the fruit was practically worthless for eating purposes, however, the sand pear was never extensively grown in this country.

About 1870 a satisfactory cross was made between a variety of the European pear and the sand pear. The new pear, the

result of this cross, was named Kieffer, in honor of its originator, Peter Kieffer, of Philadelphia, Pennsylvania. Later crosses between the European pear and the sand pear resulted in the varieties LeConte, Garber, and others. These hybrids, owing to their resistance to fire blight and to the fact that they would thrive in the South under conditions that would cause other varieties to fail, created considerable interest in pear growing. Within recent years, however, it has been discovered that these hybrid varieties are not as resistant to fire blight as was formerly supposed.

COMMERCIAL CLASSIFICATION

7. From the standpoint of the commercial orchardist, pears may be divided into two classes: *dwarf pears* and *standard pears*. This classification is based on the method of propagation.

8. **Dwarf Pears.**—A pear tree propagated by the budding of pear wood onto quince stock is known as a dwarf tree. As a rule, the Angers quince is used as propagating stock, although in some sections where the climate is mild the Portuguese quince has proved satisfactory. Dwarf trees are dwarfed in habit, are productive, and come into bearing at an early age.

In the case of some varieties of pears, there are important advantages in the growing of the trees as dwarfs. High-quality varieties that come into bearing late, such as the Comice, Glout Morceau, Bosc, Anjou, Winter Nelis, and particularly the Angouleme, bear fruit of higher quality and the trees come into bearing at an earlier age when grown as dwarfs. Also, in the case of varieties that, when grown in the usual way, do not develop their ultimate qualities until the trees have borne several crops of fruit, the growing of the trees as dwarfs will cause the latent qualities to develop at once. One of the most important advantages of the dwarf form of tree is its adaptability for use as a filler in pear orchards of standard trees.

Dwarf pears have been grown in the East for a great many years but only recently has interest in dwarf trees been aroused in the West. At the present time progressive growers of the

FIG. 1



Pacific slope are experimenting with the dwarf, largely because of its value as a filler. In general, it may be said that the growing of dwarf pears is of rather small commercial importance.

9. Standard Pears.—A pear tree propagated by the budding or grafting of pear wood onto pear stock is known as a standard tree. Standard pear trees are longer lived than dwarf trees, attain larger size, and are capable of yielding heavier crops of fruit, but they usually come into bearing later. A large percentage of the commercial orchards at the present time are of standard trees, although there are a number of dwarf orchards in the East and a few in the West. Owing to the fact that standard trees are almost exclusively grown in most sections, the following discussion of pear culture will deal largely with this form of tree. A young pear orchard of standard trees is shown in Fig. 1; this is a Western orchard and is furrowed for irrigation.

VARIETIES OF PEARS

10. Horticultural reference works written prior to a half century ago contain descriptions of hundreds and in some cases thousands of varieties of pears. A large percentage of these varieties, however, were suitable only for culinary purposes or for the production of perry. Many have become extinct and many others are now grown on such a small scale that they are practically negligible. A discussion of such varieties is unnecessary; consequently, in the following descriptions, mention will be made of only such varieties as are of importance at the present time. The name used in each case is the one adopted by the American Pomological Society, the recognized authority on nomenclature.

11. Varieties of the European Group.—The following are the most important varieties of the European group of pears:

12. The Chambers, or *Early Harvest of Kentucky*, variety is commonly known as the *sugar pear*. The tree is an upright grower. The fruit is small and roundish; the skin is of a yellowish color, which often becomes a brown, and is dotted with

green; the flesh is sweet but has a tendency to be dry unless the fruit is picked before it is too ripe. The Chambers is one of the earliest pears grown, ripening in early July in the latitude of Southern New York. The variety is desirable for home orchards but is not very satisfactory for commercial planting, owing to the fact that the fruit will keep but a few days after being picked.

13. The **Bloodgood** variety of pear originated on Long Island, New York. It has become of considerable importance in California. The tree is generally hardy, comes into bearing early, and produces an abundance of fruit. The fruit is of medium size; the skin is yellow, with russet dots and network markings; the flesh is yellowish white, buttery, melting, and of a rich, sugary, aromatic flavor. The Bloodgood ripens in midsummer. Like most early pears, it is better if picked early and ripened indoors. The variety is excellent for home orchards, and the fruit, on account of its earliness, often sells well on the market, although it is not very attractive in appearance.

14. The **Giffard** is a popular variety in Southern Canada and in parts of New York and in the New England States. The tree is fairly vigorous, reasonably productive, and healthy, but tends to be a scraggly grower. The fruit is medium to large in size; the skin is of a light-green color, often marbled and dotted with red on the exposed side; the flesh is white, juicy, melting, and of a vinous flavor. In northern states the fruit ripens about the middle of August. The Giffard is considered a good variety for home markets.

15. The **Koonce** variety originated in Illinois. The tree is hardy, productive, and healthy, tending to bear regularly. The fruit is large to medium in size; the skin is greenish yellow in color and has small russet dots; the flesh is white, often granular, and of only fair quality. In the latitude of Missouri the fruit ripens in midsummer; in northern states it ripens in October. The variety is especially valuable for use as stock in double working the pear on the quince. Koonce pears are used for culinary purposes.

FIG. 3



FIG. 2



16. The **Clapp Favorite** variety originated in Massachusetts. The tree is a strong grower, tending to be rather upright but spreading considerably when fruiting, and is very productive. The fruit is large; the skin is a pale yellow, marbled and splashed with crimson on the exposed side, and thickly sprinkled with brown dots; the flesh is white, fine grained, juicy, sweet, and vinous in flavor. A Clapp Favorite pear is shown in Fig. 2. The fruit ripens about 10 days before that of the Bartlett; it should be picked before it is fully ripe. The Clapp Favorite is one of the best varieties for home orchards and is grown extensively in commercial orchards. It is a valuable pear for canning.

17. The **Bartlett** pear is of European origin, being known in Europe as the *Williams Bon Chretien*. It is the leading commercial variety, is in demand on the market, and is one of the most profitable pears to grow. The fruit is large and varies somewhat in form; the skin is thin and of a bright-yellow color, often blushed on the exposed side; the flesh is white, juicy, and of a very good quality. A Bartlett pear is illustrated in Fig. 3. The fruit of this variety is excellent for canning, preserving, and evaporating. The season of the Bartlett is midsummer.

18. The **Tyson** is a well-known American variety that is grown extensively in home orchards. The tree is upright, vigorous, and productive. The fruit is medium in size; the skin, when the fruit is fully ripe, is yellow, is sometimes russeted on one side, and often has a red cheek that is dotted with brown; the flesh is a yellowish white in color, juicy, sweet, and variable in texture. The season of this variety is about the same as that of the Bartlett.

19. The **Flemish**, or *Flemish Beauty*, variety is of European origin; it is known by different names in different countries. The tree is vigorous and hardy and tends to come into bearing at an early age, after which it usually bears heavy crops. The fruit is generally large; the skin is of a yellow color, often marbled and covered with patches of light russet; the flesh is white, juicy, and sweet, and is of a very good quality.

FIG. 5



FIG. 4



In the latitude of New York the season of the Flemish is September.

20. The **Hardy** variety is a summer pear in some localities, an early autumn pear in others, and a late autumn pear in still others. The tree is a strong, erect grower, and has an abundance of foliage. The fruit is large; the skin is of a greenish color, often russeted; the flesh is rich in flavor and delicious. A Hardy pear is shown in Fig. 4. The fruit of this variety is well received in some markets.

21. The **Seckel** pear was originated in Pennsylvania. The tree is generally small with a rounded head; it is likely to be a slow grower but is fairly hardy and, as a rule, healthy. Often the tree is late in coming into bearing but when once in bearing it is a reliable cropper, provided it is cared for properly. The fruit is very small, but what it lacks in size it makes up in quality; the skin is a yellowish brown, with a russet-red cheek; the flesh is fine grained, sweet, very juicy, melting, and buttery, being excellent for eating in the natural condition or for pickling and spicing. A Seckel pear is shown in Fig. 5. Because of the small size of the fruit, the Seckel does not meet with much demand in many markets, but in markets where it is well known it is highly appreciated and brings good prices. The season is from the last of August to the last of October.

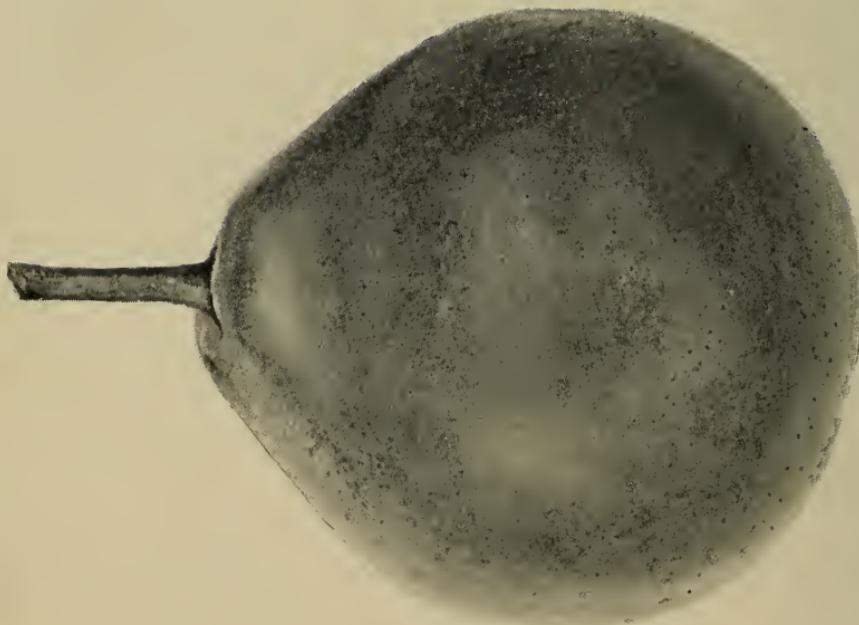
22. The **Worden**, or *Worden's Seckel*, variety of pear is said to be an improvement over the Seckel, the fruit having better keeping qualities and being handsomer. The tree is fairly hardy and productive and bears fruit in clusters. The fruit is of medium size; the skin is of a yellowish-brown color, with a russet-red cheek; the flesh is juicy and delicious. The Worden ripens in October but will keep until December. It is used for dessert purposes.

23. The **Lincoln** is a promising new variety of pear. A great many pears have been put on the market under this name, but most of these are worthless. The tree, it is claimed, is resistant to blight. The fruit is said to be large and of splendid quality; the skin is a clear yellow, with a red cheek;

FIG. 7



FIG. 6



the flesh is firm, rich, juicy, and of high flavor. The propagators claim that the fruit is excellent for both dessert and canning purposes. Owing to lack of data it is impossible to state whether or not this variety justifies the claims made for it.

24. The **Howell** variety of pear originated in Connecticut. The tree is generally a vigorous grower of upright habit, comes into bearing early, and when of bearing age, usually bears annually. The fruit is large; the skin is of a light-yellow color, often almost red on one side; the flesh is white, mellow, and rather juicy. A Howell pear is illustrated in Fig. 6. In northern sections the Howell matures from the middle of September to well into October. The variety is increasing in popularity on the Pacific coast, due largely to the handsome appearance of the fruit and to the fact that the trees have a tendency to be annual bearers. The Howell is a dessert and market pear.

25. The **Vermont Beauty** variety of pear is said to have been originated in the Lake Champlain district of Vermont. The tree is hardy and vigorous. The fruit is of medium size and tends to be round; the skin is yellow, often tinged with pink; the flesh is of very good quality. The season of this variety is October. The Vermont Beauty is a dessert pear.

26. The **Sheldon** pear is very popular in some sections of the eastern part of the country. The tree is an upright, vigorous grower, generally being round headed, and tends to bear early. The fruit is of medium size and roundish; it is often affected by core rot, due, no doubt, to hanging on the tree too long. The skin is of a greenish-yellow color, covered with a thin russet, and often is blushed with a light red on the side exposed to the sun; the flesh is sweetly aromatic in flavor and is juicy. A Sheldon pear is shown in Fig. 7. In the region of Southern New York the Sheldon matures in October. The variety is favorably received in many markets.

27. The **Angouleme** variety, known also as the *Duchess* and the *Duchess d'Angouleme*, is of French origin. The variety

FIG. 9

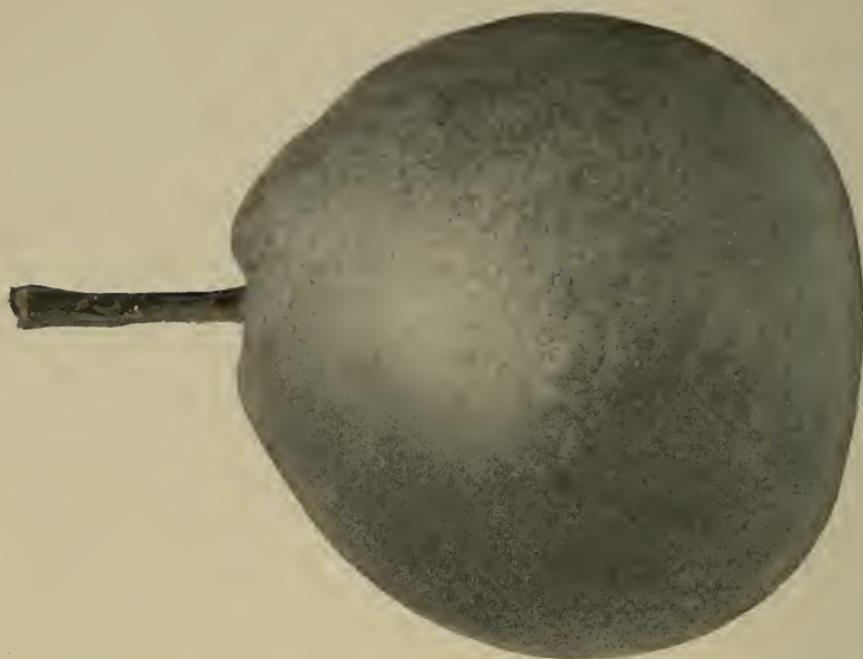


FIG. 8



is grown extensively along the Atlantic seaboard. The tree is generally vigorous; and the wood does well when grafted onto that of other varieties or onto that of the quince. The fruit varies in size from large to very large; the skin is of a greenish-yellow color, and is more or less streaked and spotted with russet; the flesh is white, juicy, and of fine flavor. An Angouleme pear is shown in Fig. 8. In the latitude of Southern New York the fruit matures in October and November. If the Angouleme is properly grown it is an attractive pear of good quality, but it must be properly grown to be profitable. The pears are valuable for both dessert and culinary purposes.

28. The **Malines** pear, often called the *Josephine de Malines*, is a very popular variety in Europe. The tree tends to be hardy and is a good bearer. The fruit is medium to large in size; the skin is yellow, tinged with green on the shaded side and blushed with red on the exposed side, and is covered with russet dots; the flesh is yellow tinged with red, melting, sugary, juicy, and of good quality. A Malines pear is shown in Fig. 9. The fruit matures late in the fall and has extremely good keeping qualities.

29. The **Drouard** variety, known also as the *President Drouard*, is a European pear that has been grown in this country for some time but only recently has come into prominence on the Pacific coast, where it has proved to be a heavy bearer, greatly outyielding the Anjou and the Comice. The tree does especially well if grown as a dwarf, bearing heavily the fourth year after planting. The fruit is large, and often irregular in form; the skin is yellow, netted and washed with russet; the flesh is creamy white, tender, perfumed, and very good. The fruit rarely is afflicted with core rot. In northern latitudes the Drouard is a fall pear, but if the fruit is well handled it can be kept until February.

30. The **Louise** variety, often spoken of as the *Louise Bonne de Jersey*, is a French pear that is well known in the northern part of the United States, in Ontario, and in British Columbia. The tree is hardy, vigorous, upright, and productive on rich soil. The fruit is large; the skin, which is

smooth, is of a greenish color, with a brownish-red cheek and numerous red and brown dots; the flesh is white, fine grained, juicy, buttery, aromatic, and of good flavor. The fruit of this variety has excellent shipping qualities. In northern latitudes the Louise pear ripens in September and October.

31. The **Clairgeau** variety of pear is noted for the attractiveness of its fruit. In fact, the mere appearance of Clairgeau pears often makes it possible to sell them for fancy prices. The Clairgeau tree is erect, is a vigorous grower, has handsome foliage, comes into bearing early, and is a heavy bearer. The fruit is very large, although different pears of the variety often vary considerably in size; the skin is very yellow and often bears cinnamon-colored streaks covered with russet dots; the flesh varies widely in quality, being very poor in some cases and only fairly good in others. In Fig. 10 three Clairgeau pears are shown at the top of the page. In the latitude of Southern New York the fruit matures in late fall.

32. The **Bosc** variety of pear was originated in Belgium, and, unfortunately, is not as well known in America as it should be. When properly grown it is one of the most delicious of pears, but its unattractive appearance has been against it. Recently, however, the public has come to know it better and the demand is constantly increasing. The tree is vigorous and bears regularly. The fruit is of large size and is generally tapering; the skin is usually of a dark-yellow color with more or less green often overlaid with a cinnamon russet, and occasionally there are streaks or dots of red; in some regions the color becomes almost an entire russet. The flesh is delicious, being melting, buttery, and very rich. In Fig. 10 four Bosc pears are shown at the bottom of the page. The Bosc keeps well in cold storage and for this reason it is becoming one of the leading winter varieties. In northern sections the fruit matures in October.

33. The **Comice** pear is a French variety that has practically topped the market for American-grown pears, shipments from the Rogue River Valley of Oregon having sold for as high as \$10 a box. It is one of the favorite varieties for the English Christmas market and keeps reasonably well in

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✓ 8) 8
✓ 4



FIG. 10



FIG. 11

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cold storage. The tree is an upright and moderately vigorous grower when young but later becomes broad and spreading; unfortunately the tree comes into bearing late and is not very productive. The fruit is usually large; the skin is of a greenish-yellow color that is often russeted and on the side most exposed to the sun the color is often a shade of crimson; the flesh is of the highest quality, being white, melting, and extremely juicy. Three Comice pears are shown in Fig. 11 at the top of the page. In northern sections the fruit matures in October and November.

34. The **Anjou** pear is becoming one of the most popular varieties grown on the Pacific coast and in many sections of the Eastern States. The tree is vigorous and has an open, round head. The fruit is usually large, is of good quality, and can be kept in cold storage until January or even February; the skin is greenish-yellow in color, with occasionally a trace of russet and a shade of crimson on the side most exposed to the sun; the flesh is fine grained, juicy, and of a rich flavor. In Fig. 11 three Anjou pears are shown at the bottom of the page. In northern sections, such as in the latitude of Chicago, the fruit matures from October to November.

35. The **Danas Hovey** variety of pear, sometimes known as the *Winter Seckel*, was originated in Massachusetts. The tree is productive. The fruit is small; the skin is generally greenish yellow; the flesh is yellow, sweet, juicy, and aromatic. This is a good variety for dessert use. The season is about the same as that of the Comice.

36. The **Gloot Morceau** is an old variety of French origin that was at one time grown extensively in the eastern part of America. It has suffered considerable damage from blight and scab and is now not grown as much as it was formerly. The variety, however, should receive attention. It is highly prized by the English trade, being considered equal to the Comice. The tree is usually spreading, and although it does not come into bearing early, it usually produces, when mature, regular and abundant crops. The fruit is generally large; the skin is a pale greenish yellow in color; the flesh is very fine

FIG. 12



22

FIG. 13



grained, white, melting, sugary, and extremely delicious. In northern sections the fruit ripens in October and November.

37. The **Diel** pear is a well-known and popular variety in England. The tree is vigorous, hardy, and productive. The fruit tends to be large; the skin is of a light green color that tends to become yellowish and is dotted and often patched with russet; the flesh is cream colored, generally fine in texture, buttery, juicy, and of an aromatic flavor. In northern regions the fruit ripens in November but will keep until January.

38. The **Mount Vernon** variety of pear originated in Massachusetts. The tree is productive. The fruit is medium to large in size; the skin is yellow, with patches of cinnamon-colored russet; the flesh is juicy, melting, vinous, perfumed, and of very good quality. The Mount Vernon is a late pear.

39. The **Forelle** variety is often spoken of in Europe as the *Trout pear*. The variety has been grown in this country for many years but only recently has attracted much attention. It is doing especially well in the Santa Clara region of California and for the last few years has brought fancy prices. The tree is hardy and bears good crops. The fruit is very attractive; the skin is of a greenish color, turning to yellow, and is washed with deep red and speckled with crimson dots; the flesh is white, very delicate, melting, and rich. The Forelle needs warm soil and a sunny exposure. The season is late fall but the fruit can be kept until February.

40. The **Lawrence** pear is one of the hardy winter varieties that is much valued in the eastern part of the United States. The tree is usually a good bearer and makes a moderate growth. The fruit is medium in size; the skin is of a light-yellow color, with some russet; the flesh is melting, sweet, aromatic, and juicy. A Lawrence pear is shown in Fig. 12. In the latitude of Southern New York the fruit ripens in December.

41. The **Columbia** pear is grown to some extent in California and in parts of the South. The tree is a handsome grower and a good bearer. The fruit is large; the skin is of a

FIG. 15



FIG. 14



greenish-yellow color; the flesh is of good quality. A Columbia pear is shown in Fig. 13. This is a late winter variety.

42. The **Winter Nelis** is perhaps the most popular of the winter varieties. The tree often comes into bearing rather late. The fruit often tends to be rather small but when well grown it is of superb quality. The pears are yellow in color but may have patches of russet; the flesh, when the fruit is well grown, is very fine grained, buttery, sweet, juicy, and of good quality. A Winter Nelis pear is shown in Fig. 14. The pears of this variety keep well if properly handled, and often bring high prices. The Winter Nelis should be planted on deep, rich soil and the crops should be thinned well.

43. The **Patrick Barry** is considered a desirable variety by some persons and by others it is considered too inferior to grow. The fruit is of exceptionally good keeping quality, specimens having been kept for more than a year. The variety has displaced the Winter Nelis in some regions. The tree comes into bearing early and tends to bear annually. The fruit is rather large; the skin varies from almost a complete russet to a rich golden russet on a deep yellow; the flesh is usually very juicy and melting, but is extremely variable in quality. The Patrick Barry matures in late winter.

44. The **Easter Beurre** variety of pear is grown somewhat extensively on the Pacific coast, particularly in California. The tree is a moderate grower, has a round head, and, under favorable conditions, is a good bearer; it must, however, be grown on rich soil. The fruit is large; the skin is usually yellow, which may be somewhat russeted, and often brownish on one side; the flesh is fine, white, sweet, and juicy. The Easter Beurre is a late winter variety; the fruit often keeps until April.

45. Varieties of the Oriental Group.—The following are the most important varieties of the Oriental group of pears:

46. The **Kieffer** pear is a hybrid that is supposed to be a cross between the sand pear and some European variety such as the Bartlett. It is the most popular variety in the South and in parts of the Middle West, and is increasing in popularity.

FIG. 17

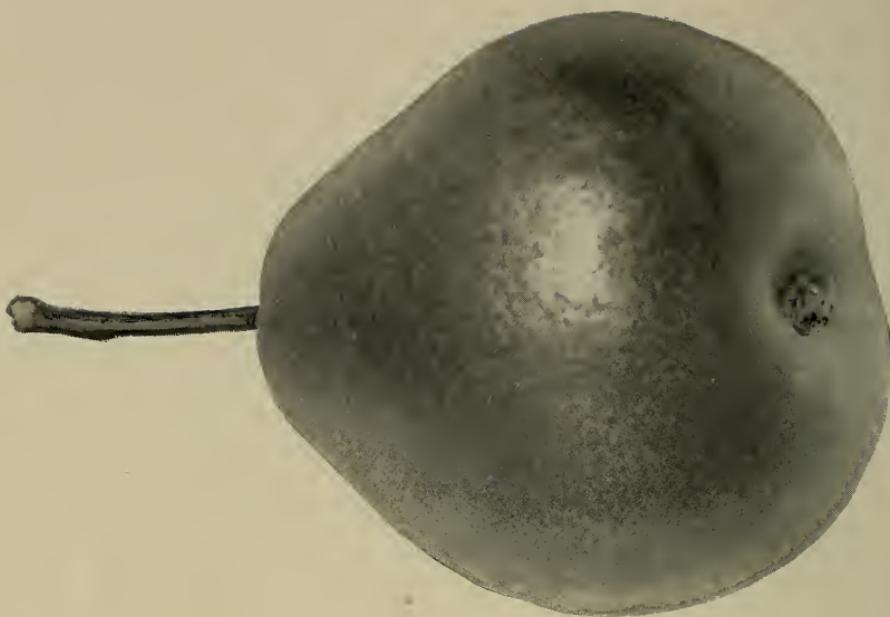


FIG. 16



elsewhere, particularly for cooking purposes. The Kieffer has always been noted for its resistance to fire blight. The tree is vigorous and very productive. The fruit keeps and ships well, and will probably stand rougher handling than that of most other common varieties. It is an inferior pear for eating as it comes from the tree but is of merit for canning and preserving. The fruit is from medium to large in size; the skin is yellowish in color with a tinge of red on the exposed side, and is often sprinkled with small russet dots; the flesh is coarse and juicy. A Kieffer pear is shown in Fig. 15. In the latitude of Southern New York the fruit ripens in October and November. The Kieffer is not a valuable variety north of the 43d parallel of north latitude.

47. The **LeConte** is another hybrid variety that was originated by a cross of the sand pear and the European pear. The tree is, as a rule, a vigorous grower, prolific, and hardy. The fruit is large; the skin is yellowish in color; the flesh, like that of the Kieffer, is of poor quality. A LeConte pear is shown in Fig. 16. In the latitude of Southern New York the fruit matures in October and November. The LeConte succeeds best in the extreme southern part of the United States.

48. The **Garber** is a pear of the Kieffer type, but its season is much earlier than that of the Kieffer. The tree is fairly free from blight, is hardy, healthy, and productive. The fruit is large; the skin is a beautiful bright yellow in color; the flesh is of poor quality. A Garber pear is shown in Fig. 17.

49. The **Cincincis** is an oriental variety of the Kieffer type that succeeds as far south as Southern Florida. The tree is a heavy bearer. The fruit is large and rough in appearance; it is much like the Kieffer in quality. The pears are used for culinary purposes.

50. The **Sewanee** is a comparatively new variety that was originated in Southern Georgia. It is said to be very resistant to fire blight. The tree bears annually and is a heavy yielder. The fruit is large and of good color. This variety does well in Florida.

51. The **Golden Russet**, or *Japan Golden Russet*, variety is a hybrid that stands heat and drouth well. The tree is a vigorous grower, strong, free from blight, and very productive. The fruit is large, nearly round and very firm; the skin is entirely covered with russet; the flesh is firm and juicy. The pears are used largely for cooking and canning.

PEAR PESTS AND INJURIES

DISEASES

52. There are very few diseases that affect the pear seriously. One, however, the *fire blight*, is one of the most destructive and serious plant diseases found in America at the present time. In some sections the pear is seriously affected by *pear scab*, a disease that closely resembles apple scab. Also, at times, a disease known as *pear-leaf blight* is troublesome. Occasionally, *pear-leaf spot*, *rust*, *crown gall*, and *brown rot* cause damage. With the exception of fire blight, however, the diseases of the pear are not particularly formidable.

53. Fire Blight.—The fire-blight disease of the pear has for many years been a terrible menace to the pear-growing industry, and besides, has destroyed many quince and apple trees. The name of this disease is well chosen, as an affected tree, with its shriveled branches and shrunken, blackened twigs, has the appearance of having been injured by fire. The disease is caused by bacteria, consequently spraying is of no value whatever in combating it.

Generally, the first warning that a grower has of the presence of fire blight in his orchard is the wilting of the twigs on one or more of the trees. Often but one or two twigs on a tree are affected at first, and in this case the disease is not very conspicuous. Soon after the twigs wilt the foliage turns black and the wood dies.

In Fig. 18 is illustrated the appearance of blight-infected twigs. In some instances the attack may be light, the blight going no farther than the twigs and spurs; in other instances

it may run rapidly down the trees to the main branches and even to the roots. If the disease is confined to the twigs, spurs, and small branches, it often dies out without causing much damage; if, however, the large branches and the trunk are affected, the tree may die in a short time or the disease may remain as what is called *hold-over blight*.

If a grower will go through his orchard during the dormant season he should be able to find all patches of wood affected with hold-over blight. When the disease is in an active state, as it is in hold-over blight, it can be detected to a certain degree by the discoloration of the wood, which is generally somewhat reddish in color. All suspected patches should be cut into and if the inner bark is of a bright reddish color and is soggy with sticky sap, the grower should consider this evidence as being sufficiently conclusive to warrant the destroying of the affected wood. If the symptoms are not very pronounced it is advisable for the grower to consult some person who has had experience with the disease.

In early spring, patches of wood affected with hold-over blight exude sap, as shown in Fig. 19. This sap is teeming with the causal bacteria.

Insects, such as bees and wasps, are attracted by the sweet juice, which adheres to them, and consequently become agents of infection. The insects carry the bacteria to blossoms on other trees and often to wounds on the branches and trunks, and thus spread the disease.

The susceptibility of a pear tree to fire blight is largely influenced by external conditions. A general statement may be made that any condition that causes a tree to make a very rapid growth, resulting in tender shoots, favors the development



FIG. 18

of the disease. From this it may be deduced that the pear should not be planted on rich soil, that it should not be over-stimulated with nitrogenous fertilizers, and that the amount and time of cultivation should be governed by the rate of growth of the trees. Also, varieties differ considerably in their susceptibility to fire blight. The Kieffer, LeConte, Garber, Winter Nelis, and Angouleme are less susceptible than the Flemish, Bartlett, Seckel, and Clapp Favorite. In general, varieties of the Oriental group are much more resistant to fire blight than those of the European group. At one time it was thought that the Kieffer was absolutely resistant, but this has been found to be erroneous.

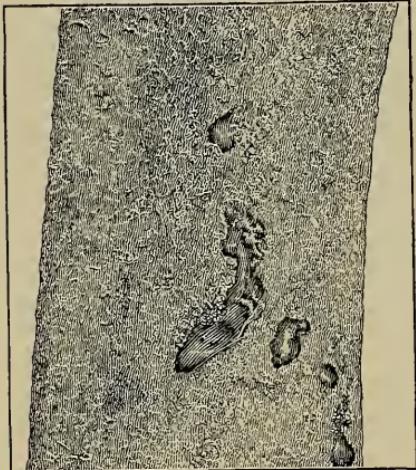


FIG. 19.

It has been conclusively demonstrated that where climatic conditions are favorable and growers are willing to combat the disease by proper methods, it is possible to hold fire blight in check. Orchards must be inspected frequently, both in summer and in winter, and all affected wood must be cut out and destroyed. In cutting out blighted wood, the cut must be made considerably below the point of attack.

Before each cut is made the pruning implement must be sterilized with a strong antiseptic; a 1-to-1,000 solution of corrosive sublimate, or bichloride of mercury, is generally used. A convenient method of applying the antiseptic is to wipe the implements with a sponge soaked in the solution. This sterilizing is absolutely necessary, as otherwise bacteria may be carried from infected wood to wood that is not infected. Great effort should be made to cut out all patches of wood affected with hold-over blight, so that there will be no exudation of infected sap in the spring.

Occasionally, pear trees will bear scattering blossoms in the summer, especially if they have been injured by frosts in the

spring. These late blossoms are a disadvantage if fire blight is prevalent in the locality, as they will be visited by insects that bear the bacteria and thus will become centers of infection. When fruit buds appear in summer they should be immediately removed.

As has already been stated, fire blight is much more prevalent where the trees have made too rapid growth. For this reason, care must be exercised in the selection of an orchard site and in the cultivating, fertilizing, and irrigating of the trees. These points will be discussed in the subsequent Section.

54. Pear Scab.—The fungous disease known as pear scab is often very troublesome in regions that are subject to warm, humid conditions in late spring and early summer. It seems to be more prevalent, too, in the Eastern States than on the Pacific coast. Pear scab is so similar to apple scab, which has already been described in a previous Section, that a discussion of its life history and characteristics is not necessary. It often causes much of the fruit to fall and the affected pears that remain on the tree are scabby and much deformed.

Fig. 20 illustrates the appearance of pears affected with the disease.

Plant pathologists differ as to the treatment that should be given to prevent pear scab. Some recommend winter spraying and others consider this unnecessary. In general, however, the following synopsis of the spraying required is agreed on by all:

1. Just as the fruit buds are showing a pinkish color, but before they open, spray with Bordeaux mixture or lime-sulphur solution. If Bordeaux mixture is used, it should be of the 3-3-50 formula; if lime-sulphur solution is used, it should be of the summer strength.

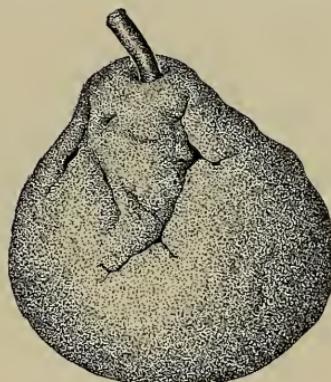


FIG. 20

2. When most of the petals have dropped, spray again with either Bordeaux mixture or lime-sulphur solution as recommended in paragraph 1.
3. From 10 days to 2 weeks later spray again.
4. From 10 days to 2 weeks later spray again.

55. Pear-Leaf Blight.—The fungous disease known as pear-leaf blight attacks the foliage and sometimes the fruit of the pear and the quince. Occasionally it becomes so bad that it defoliates the trees, or at least weakens them so that the foliage turns yellow. At times the disease becomes very bad in nurseries; at one time it discouraged American nurserymen from propagating the pear.

A characteristic symptom of pear-leaf blight is the spotted appearance of the leaves. The spots, which are particularly

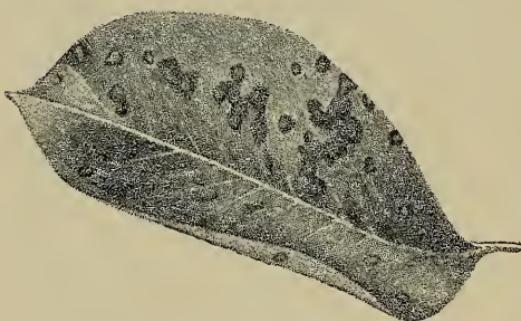


FIG. 21

evident on the upper surface of the leaves, have a reddish center with an outer border of a dark shade. In case the blight attacks the fruit, the reddish spots appear and usually crack. It should be understood, however, that spots

on the leaves and cracks in the fruit do not always indicate leaf blight; other diseases have much the same symptoms.

The spraying treatment already recommended for pear scab will usually hold the pear-leaf blight in check.

56. Pear-Leaf Spot.—The fungous disease known as pear-leaf spot occurs principally in the eastern part of the United States. It attacks the leaves of orchard and nursery trees, often causing premature defoliation. Affected trees are not seriously injured unless the leaves fall, in which case they may show a reduction in vigor the next season. The spots on the leaves may readily be distinguished from those of the leaf blight by their color. Three fairly well differentiated zones of

color may usually be seen in a spot: the center zone is ashen gray, the surrounding zone is brown, and the outer zone is purplish. These color details are lost in old leaves, but they are, as a rule, prominent in fresh ones. The general appearance of an affected leaf is shown in Fig. 21. Some varieties, like the Clairgeau, Anjou, Bosc, and Bartlett, suffer more from the disease than varieties like the Winter Nelis, Kieffer, and Angouleme.

The spraying already recommended for pear scab is effective in preventing the leaf-spot disease.

57. Rust.—The rust that attacks the pear is very similar to the rust of the apple, although it is, as a rule, less injurious. Two stages of the disease occur: a summer stage and a winter stage. The summer stage produces the rust found on the leaves of the pear and the winter stage causes the familiar cedar apple of the cedar tree. The remedy, as in the case of the apple, is to remove all red cedar trees from the neighborhood of the orchard, thus eliminating the source of infection. If this is impossible, the trees should be sprayed with Bordeaux mixture immediately after the early spring rains, as recommended in the case of the apple.

58. Crown Gall and Brown Rot.—The pear, like the apple, is attacked by crown gall and brown rot. Inasmuch as these diseases have already been described in a previous Section, further discussion is unnecessary.

INSECTS

59. Most of the common insects that attack the pear also attack other fruits such as the apple, peach, and plum. Some of these insects have already been described in previous Sections, consequently a full discussion of them is unnecessary here. The most important insect enemies of the pear are: the *pear psylla*, *pear thrips*, the *leaf-blister mite*, the *pear slug*, the *San José scale*, the *coddling moth*, the *green apple aphis*, the *fruit-tree bark beetle*, the *oyster-shell scale*, the *scurfy scale*, and *borers*.

60. Pear Psylla.—In some parts of the United States, especially in New York State, an insect known as the pear psylla has become a serious pest in pear orchards. The presence of the psylla in injurious numbers on a tree is usually indicated by an abundance of a waterish, sticky liquid, called honey dew, at the axils of the leaves and fruits. In New York State this may be first detected during the latter part of May or early in June. This liquid later becomes covered with a black mold, which gives the trees a blackish, unsightly appearance. Certain ants and flies are very fond of the honey dew, and often congregate in large numbers on infested trees. The presence of these insects on a pear tree should arouse the suspicions of an orchardist and should lead to a close inspection of the trees.

The adult psylla is an active four-winged insect, measuring about $\frac{1}{16}$ inch in length. It has been compared to a miniature

seventeen-year locust. An adult psylla is shown in Fig. 22 (a). The winter adults appear early in spring and deposit eggs for the first brood in protected places in the bark. The eggs hatch in a few days, and the young larvae, or nymphs, one of which

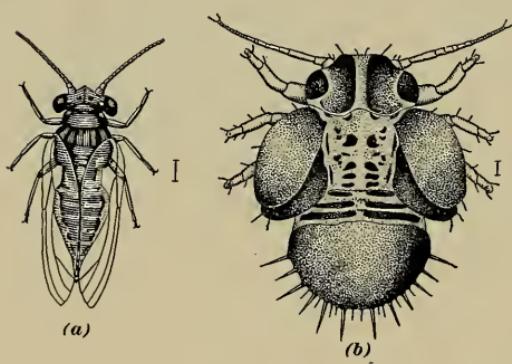


FIG. 22

is shown in Fig. 22 (b), at once begin to suck the juices from the young leaves and twigs. A favorite place for the young larvae is in the axils of the leaves at the base of the fruit stems. Two or three days after hatching, the larvae cover themselves with honey dew, which finally becomes so abundant that it besmears the leaves and fruit. The extent of the injury done in this way varies, of course, with the number of the larvae. When the larvae are very numerous they take so much nourishment from the trees that the new growth is seriously checked. The whole tree assumes a stunted, unhealthy appearance. As a result, the fruit crop is greatly

lessened and in some cases the trees are killed. Trees weakened by the psylla often fail to survive the winter.

The following control measures for the psylla have been recommended by the New York Agricultural Experiment Station:

1. Practice clean culture in the orchard so that there will be no accumulations of weeds to serve as wintering places.
2. Remove all rough bark in order to prevent the adults from wintering on the trees and to render them more exposed to spraying mixtures. Bark is most easily detached immediately following a wet period. Care should be exercised not to cut into live tissue.
3. Spray thoroughly to kill the adults with Blackleaf 40, a commercial nicotine preparation, using $\frac{3}{4}$ pint to 100 gallons of water, and 3 pounds of soap; the spraying should be done preferably during a warm period in November or December, or during March or early April. Select a day when the mixture will not freeze on the trees. For spring spraying, some growers prefer a miscible oil, using 1 gallon diluted with 15 gallons of water.
4. Spray the trees thoroughly with lime-sulphur mixture of the winter strength to destroy the eggs. This treatment should be made during the latter part of April or early in May, or just before the blossom clusters open.
5. Spray the trees thoroughly just after the blossoms drop to kill the newly-hatched nymphs, using Blackleaf 40 as in paragraph 3, and 3 pounds of soap or kerosene emulsion diluted with 8 parts of water. Direct the spray into the axils of the leaves and fruits and wet both surfaces of the leaves.

If the work is well done it is not necessary to carry out all of these measures each year. If the trees have been carefully scraped a combination of the treatment recommended in paragraphs 3 and 4 or 3 and 5 should be sufficient. Some growers have entirely controlled the psylla with only the treatment recommended in paragraph 3.

61. Pear Thrips.—In California, particularly in Santa Clara, Contra Costa, Solano, Alameda, Yolo, Sacramento,

Napa, and Sonoma counties, the pear thrips is at present the most important insect pest with which pear growers have to contend. This insect attacks not only the pear but also all other deciduous fruits. The extent of damage done by the thrips in recent years has been so enormous that special agents have been detailed by the United States Department of Agriculture to study the insect.

Injury by the thrips is caused by the feeding of the adults on the developing buds and early blossoms; by the deposition of eggs in the fruit stems, leaf stems, and newly formed fruit; and by the feeding of the larvae in the blossoms and on the young fruits and foliage. On pears the greatest injury is



FIG. 23

produced by the adults, which often prevent the trees from blooming. The feeding injury is not produced by a biting or chewing process. By rasping the tender surfaces of the developing fruit buds and the young fruits with their hardened mouth parts, the thrips rupture the skin, causing an exudation of sap, which is often followed by more or less fermentation, especially before blooming.

The adults, one of which is shown greatly enlarged in Fig. 23, first appear on the trees about the middle of February and emergence from the ground continues until early April. By the time the fruit buds have swollen sufficiently to separate the bud scales slightly at the tip, the adults force their way within, feeding on the tenderest parts inside the buds. When

the thrips are present in sufficient numbers the buds are completely destroyed and the trees fail to bloom. As soon as the first leaf surfaces or fruit stems are exposed egg laying usually begins. The first eggs are deposited about the last of February and oviposition continues until near the middle of April. Most of the eggs are deposited just under the epidermis in the fruit stems, in young fruit, and in leaf stems. The eggs hatch in from 5 to 17 days, the average time being about 8 days. By the time the trees are breaking into full bloom the adults have done most of the damage caused by their feeding, oviposition is at its height, and many of the earlier-appearing adults are dying off and larvae are beginning to appear in numbers. The first larvae can usually be found about March 20, and are in maximum numbers on the trees, feeding on the small fruit and young foliage, from the first to the middle of April. Reaching their full development, the larvae drop from the trees, of their own accord or with falling calyxes, or are blown by wind or knocked off by rain. After the middle of April the number on the trees diminishes rapidly, and by the last of April all the larvae are off the trees and in the ground. Here they work down into the first 3 or 4 inches of hard soil below the loose surface mulch and construct a tiny cell, where they remain until the following spring. Pupation takes place in the ground and the insects emerge as adults.

A great deal of experimental work has been done with a view to finding an effective means of controlling the pear thrips, but as yet no entirely satisfactory method has been discovered. In view of the fact that new information concerning this insect is continually being brought to light and that any recommendation made for its control would likely soon be out of date, it is not deemed advisable here to give any of the experimental control measures. In case an infestation of thrips occurs the owner of the orchard should consult the nearest experiment station.

62. Leaf-Blister Mite.—The leaf-blister mite that attacks the pear and other horticultural crops is not a true insect; it belongs to the same class of animals as the spiders, scorpions, etc. The mites are very small, being invisible to the unaided eye.

The mites pass the winter on the trees, under the bud scales, and attack the leaves as soon as these begin to push out in the spring. They bore small holes from the under side to the interior of the leaf, where they deposit their eggs, and with their progeny feed on the tender cells of the leaf substance. Their activities within the leaf tissues quickly result in the development of galls, or swellings. These are at first small, pimple-like eruptions, especially evident on the upper surface of young leaves, and are of a reddish tinge. The spots soon increase in size, the largest becoming as much as $\frac{1}{8}$ inch in diameter. On

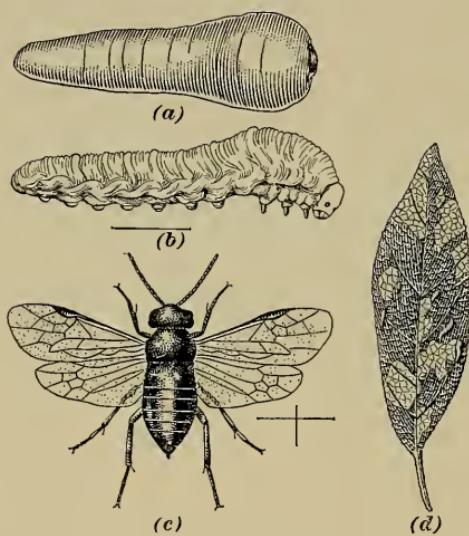


FIG. 24

pear leaves the spots, as a rule, become red as they grow. On the under side of the leaf the galls are whitish and blister-like, not differing much from the general color of the leaf surface. Later they turn brownish or black, due to the death of the injured leaf cells, lose much of their thickness, and some may become somewhat shrunken. If orchards are sprayed thoroughly to prevent San José

scale, no additional spraying is likely to be necessary to hold in check the leaf-blister mite.

63. Pear Slug.—The pear slug, which attacks the pear and cherry and sometimes the plum, is often found on pear trees in May and June, or later. The slugs skeletonize the upper surface of the leaves, which are likely to fall prematurely. In the case of young trees the entire foliage may fall. The slugs are dark, sticky larvae about $\frac{1}{2}$ inch in length; they are large at the head end and taper gradually. Fig. 24 (a) shows a larva in the normal state; (b) shows a larva with the slime removed;

(c) shows the adult, or parent, which is a saw fly about $\frac{1}{5}$ inch long; and (d) shows the work of the larvae on a leaf. The saw flies lay eggs in the leaves about the time the foliage is out, and from these eggs the slugs hatch.

Pear slugs may be easily destroyed by spraying infested trees with any of the arsenicals when the work of the pests is first noticed. They may also be destroyed by whale-oil soap (1 pound of soap to 4 gallons of water) used as a contact insecticide. Hellebore, air-slaked lime, or almost any fine dust will, if thoroughly dusted over the trees, destroy most of the larvae.

64. San José Scale.—The San José scale attacks the pear as badly as it does other fruits. However, the pest does not cause as much alarm as it did at one time, owing to the discovery of effective control measures and the dissemination of information concerning it. The control measures are much the same in the case of all fruits.

65. Coddling Moth.—The coddling moth is much less injurious to the pear than it is to the apple, and in many pear-growing regions little attention is paid to it. Occasionally, however, it does considerable damage to a pear crop. If the pest is sufficiently injurious to warrant spraying, the same control measures recommended in the case of the apple should be used.

66. Green Apple Aphis.—The green apple aphis is frequently found on very young pear trees and sometimes on older ones. If the pest is properly combated it is comparatively easy to control, but, as a rule, growers discover its presence too late to prevent damage to the trees. The control measures are the same as in the case of the apple.

67. Fruit-Tree Bark Beetle.—The fruit-tree bark beetle is more likely to attack diseased or dying trees than healthy trees and is often found in neglected orchards. As a rule, if an orchard is properly cared for serious attacks by this pest will not occur. In case the trees become badly infested it is sometimes advisable to remove and destroy them. A thorough discussion of this insect has already been given in a previous Section.

68. Oyster-Shell Scale and Scurfy Scale.—The oyster-shell scale and the scurfy scale sometimes attack pear trees, but generally the attacks are confined to trees that are low in vitality. The control measures are the same as in the case of the apple.

69. Borers.—The three borers that attack the apple, namely, the round-headed borer, the spotted borer, and the flat-headed borer, also attack the pear. The control measures are the same in both cases. —————

MISCELLANEOUS INJURIES

70. Frost Injuries.—Pears bloom early in the spring, earlier than most apples, and for that reason they are often damaged by frosts. Orchards planted on unfavorable sites are, of course, more likely to be injured by frosts than orchards planted on favorable sites, but even if the site has been selected with considerable care, occasional injuries are likely to occur.

There are several ways in which pears may be injured by frost. If a severe frost occurs while the trees are still in bud, the buds will usually turn black and fall off. If the frost occurs while the trees are in bloom, the pistils of the blossoms will generally die and a large percentage of the blossoms will fall from the tree. Pears produced from the blossoms that remain may be small or they may be fairly good sized, but in either case they will be unusually thick at the neck, especially around the stem, this giving the fruit somewhat of an unnatural appearance; such pears are seedless. If a severe frost occurs after the petals have fallen and the fruit has set, a considerable percentage of the young pears will drop, and much of the fruit that does not drop will be injured in various ways. A common form of fruit injury is what is known as *neck ringing*. By this is meant the forming of a band of russet around a pear, usually on the neck. Pears thus blemished are sold as culls. Again, the injury may be of such a nature as to retard the growth and development of the fruit.

Unfortunately, it is impossible to give accurate information regarding the exact temperature at or below which pears will

be injured by frost. Many tables have been published giving the temperature at which frost injury begins, but these have been found to be only local in their application. For example, in most of the tables published so far, a temperature of 29° F. is given as the minimum that fruits will withstand, but in the Willamette Valley of Oregon a temperature of 25° F. has been withstood by pears. The moisture content of the atmosphere, the presence of fogs, cloudy weather, all have a bearing on the amount of frost that plants will withstand. However, the general statement may be made that a temperature lower than 29° F. is likely to be disastrous to a fruit crop. If a grower is located in a region where the temperature drops to this point or lower it is advisable for him to provide some artificial means for protecting the orchard.

Recent investigations have demonstrated that the artificial heating of orchards by smudge pots is of great value when the temperature is low enough to menace the crop. The use of the pots has already been explained in a previous Section.

71. Sun Scald.—In spring, the weather is often very warm during the day and rather cold at night. Under such conditions the sap of the trees will start to rise rapidly and will get chilled, and as a result, the trees will be likely to suffer from sun scald. In some sections sun scald is at times a serious trouble, especially in the case of varieties that start growth early and trees that are planted on light soils.

The preventive measures against sun scald already recommended in the case of the apple apply also to the pear.

72. Girdling of Trees.—Unfortunately, many young pear trees become girdled, due to such pests as rabbits, gophers, mice, etc. If a tree is completely girdled the top will die and, unless treatment is given, the tree may be lost. In case of complete girdling it is sometimes possible to bridge-graft a tree, but if the tree is young it is usually best to cut it off below the wound and thus force out new sprouts from which a new body can be developed.

It is difficult to control the various pests that are responsible for girdling. In the case of rabbits and gophers no doubt the

best means of control is to kill the pests with guns and traps. There are on the market rabbit-proof fences that are fairly effective, but in localities where rabbits are numerous it is unwise to depend on a fence alone to protect an orchard. The damage done by gophers is chiefly underground and the first indication of damage is the wilting of a tree or the failure of a tree to start growth in the spring. Mice can often be controlled by painting the trunks of the trees with whitewash to which has been added a considerable quantity of arsenic, strychnine, or other such poison. By keeping straw away from the bodies of trees and keeping the ground free from rubbish, mice can be prevented from wintering in the immediate vicinity of trees.

73. Sour Sap.—Pear trees occasionally suffer from sour sap. This trouble is often confused with fire blight, but the two are entirely dissimilar. Wood affected with fire blight has a reddish tinge, which is characteristic of the disease. The leaves of trees affected with sour soap often become yellow and sometimes the trees die. In all probability the sour sap condition of trees is due to excessive moisture in the ground during the early growing months, and there is a possibility that the same conditions that cause sun scald also aid in bringing about sour sap.

74. Breaking of Trees.—One of the principal causes of trees breaking is improper pruning. Breaking occurs also as a result of improper methods of propping up the branches and insufficient thinning of the fruit. The breaking of branches is often due to some form of winter injury. It may be that the heart wood has been injured and has turned black, consequently when the trees are bearing a heavy crop of fruit the branches are unable to sustain the load. Occasionally, breaking of trees and branches is due to ice and snow; young trees, especially, break because of heavy loads of ice or snow.

If trees are properly pruned, thinned, and propped the damage due to breakage is not likely to be very severe. When breaking of branches occurs, the branches should be cut back to clean wounds; if bad splits occur it is often possible to bolt

the split parts together. If most of the branches have been broken off of young trees the trees can be cut back severely or be regrafted, thus forcing out new sprouts from which a good top can be developed.

75. Bark Binding.—Pear trees are subject at times to bark binding. This trouble is most likely to be experienced when the trees are young and growing rapidly. The bark, which cannot expand fast enough to allow the tree to develop properly, becomes tough and the tree ceases to thrive. Trees are sometimes said to be bark bound when they have ceased to grow because of neglect, but this is not true bark binding, as the trees will respond to proper culture. In case of true bark binding some growers have secured good results by spraying with a soap spray or even with lime sulphur. In bad cases, relief may often be secured by slitting the bark with a sharp knife, care being taken not to cut into the wood. If trees are not forced too much in the fall, and are tilled properly in spring and summer there will be little trouble from bark binding.

76. Rough Bark.—Pear trees, especially old ones, are very subject to rough bark. At one time considerable importance was attached to this trouble, owing to the fact that investigators attributed it to a form of blight. It was called *crater blight* and was thought to be a serious disease. At the present time little importance is attached to it.

PEAR CULTURE

(PART 2)

PEAR-ORCHARD ESTABLISHMENT

SIZE FOR A PEAR ORCHARD

1. One of the first and most important points that must be considered by a prospective pear grower is the acreage to plant. This is, of course, largely an individual problem, consequently it can be discussed only in an abstract way. In general, it may be said that the most desirable size for a pear orchard can be determined only after a consideration of such factors as the nature of the locality, the kind of soil, the variety or varieties to be grown, the amount of capital available, and whether or not the orchard will be the sole source of income.

If the locality is one in which pear growing is extensively practiced it is likely that labor will be available when needed and that the transportation facilities are adequate for prompt disposal of the fruit. If, on the other hand, there are few or no orchards in the locality, it may be that labor conditions and transportation facilities are such that it would be inadvisable to make an extensive planting. Also, in a locality in which there is a wet and a dry season, more intensive cultivation is necessary, in order to conserve moisture, than in a locality where there are intermittent rains; consequently, fewer acres can be cultivated, other conditions being equal. On the Pacific coast, where the seasons are alternately wet and dry, it has been the experience of growers that under average

conditions one man can do most of the work necessary in a 40-acre orchard up to the time the trees come into bearing.

Light soils are easier to cultivate than heavy ones; consequently, if the soil of a locality is fairly light a grower will be justified in planting a larger orchard than if the soil is extremely heavy. In the case of a reasonably light soil, one man can usually cultivate about 40 acres of orchard, whereas, in the case of a very heavy soil, such as adobe, about 25 acres is all that can be handled properly. Minor soil differences are, of course, negligible and should not be considered in deciding on the acreage to plant.

If only one variety of pear is to be planted it would be unwise to plant as large an acreage as if several varieties are to be planted, as in the former case the pears would all mature at the same time, whereas in the latter case the harvesting season would extend over a considerable period. In the case of localities where the labor supply is uncertain, this is an important point to consider.

2. The capital required per acre to establish a pear orchard varies greatly in different sections and with different conditions. Considerable good pear land is available that can be purchased for from \$50 to \$150 an acre, and there are a few regions where satisfactory land can still be procured for as little as \$5 to \$10 an acre. The average planting will be about one hundred trees to the acre. Pear trees can usually be purchased for from 10 to 30 cents each, 20 cents being an average price. Estimating the planting to be one hundred trees per acre and the price per tree to be 20 cents, the trees alone will cost \$20 an acre. It will probably cost 4 or 5 cents a tree to stake the ground for planting and to plant the trees. Estimating the cost of this work at 5 cents a tree, the cost per acre will be \$5, making the total cost for merely procuring the trees and setting them \$25 per acre. It is possible, under certain conditions, to establish an orchard for as little as \$10 an acre; under other conditions, it may cost several times this amount, depending on whether the trees are purchased or are grown by the orchardist, on the kind of trees planted, and on the number

planted per acre. The cost of cultivating an orchard and otherwise caring for it up to the age of bearing varies so greatly under different conditions that it is impracticable to give an estimate. It is claimed by some authorities that an orchard can be established and cared for up to the time of bearing, provided land is purchased at a reasonable price and the orchard is properly managed; for about \$250 to \$300 an acre. In many cases the cost will be less, of course, and in other cases more.

If an orchard is to be the sole source of income to a grower it is probable that a larger planting will be made than if the orchard is merely to be a side line to some other business. It should be borne in mind, however, that in some localities where pear trees bear very irregularly it would be unwise to depend on a pear orchard for a living.

LOCATION FOR A PEAR ORCHARD

CHOOSING OF A GENERAL LOCATION

3. If a person desires to engage in pear growing and is in possession of land that is suitable for the purpose, all that is necessary is to select a number of different varieties that will develop to a high state of perfection under the conditions that prevail. If, however, no suitable land is possessed and it is therefore necessary for a grower to go into the market for land, he should choose a location where the fruit grown will be of high quality and where fire blight is either not prevalent or is under control. The pear will grow under a great variety of conditions, even greater, perhaps, than the apple. If it were not for the menace of fire blight, the growing of pears would not be particularly hazardous. As the disease is so destructive, however, extreme caution should be observed in choosing a location for an orchard. The reasons for this statement will be given subsequently.

Some of the most important points that should be considered in the choosing of a general location for a pear orchard are: The distance from market, the transportation facilities, the

quantity of pears grown in the locality, the class of people growing pears in the locality, and the climatic conditions.

4. Distance From Market.—As a factor in affecting the desirability of a location for pear growing, the distance from market is of much less importance than it was at one time. The introduction of cold-storage plants, refrigerator cars, and other improved facilities for the handling of crops has greatly lengthened the season of pears and has broadened the market. In certain sections, however, if summer and fall varieties are grown, lack of proper facilities for handling the crops will make it necessary to dispose of them in a relatively short time. Under such conditions it is of advantage, of course, to be near a large center of population where there is a demand for the fruit. In addition, if an orchard is located near a large market the expense of shipping the fruit to market will naturally be less, as a rule, than if the orchard is distant from market.

In some regions where the growers are organized, the railroads have granted a flat rate for the transporting of fruit. For example, the carload rate for pears shipped from the western part of Oregon is exactly the same as the rate that prevails in the eastern part, which is several hundred miles nearer the market than the western part. Thus, all pear growers in Oregon are able to obtain the same carload rate for eastern shipments. In addition, many of the railroads are now establishing what are known as storage-in-transit rates. Where these rates are operative a grower can ship fruit to one city, place it in cold storage, and then ship it on to another city at exactly the same rate that would have been charged had the fruit been shipped directly to the second city. As an illustration, an Oregon grower can ship pears to Chicago, place them in cold storage, and later, if desired, ship them on to Cincinnati at the same rate that he would have obtained if he had shipped the pears from his orchard directly to Cincinnati. These storage-in-transit rates are a great boon to fruit growers, as they cut down the expense of distributing a crop. At the present time there is a tendency for fruit growers' associations to establish cold-storage plants in the large centers of

population so that, by means of storage-in-transit rates, the fruit can be economically distributed to the smaller cities and towns. All of these progressive steps in the handling of fruit serve to minimize the importance of the distance from market.

5. Transportation Facilities.—Careful consideration should be given to the transportation facilities of a locality before it is chosen for pear growing. Where fast freights, refrigerator cars, and ice for precooling are available, pears can be handled much more efficiently and economically than where such service is not available. Also, it is often an advantage to be on the main line of a railroad, as the rates are likely to be lower than on a branch line. Transportation by water is generally cheaper than transportation by rail and is especially valuable for small shipments such as are made by growers where crops are not large enough to be shipped in carload lots.

6. Quantity of Pears Grown in the Locality.—It is a decided advantage to choose as a location for a pear orchard a locality in which there is a large acreage devoted to pear growing. In such a locality an orchard will, in case the owner wishes to sell it, bring a higher price than in a locality where few pears are grown. In addition, pear buyers are much more likely to visit a locality where there is a possibility that they will be able to purchase a carload or perhaps a train load of fruit than where there is only the product of one orchard to be purchased. This last is a very important point, as it is usually more profitable and satisfactory to sell fruit to a buyer than to sell it by correspondence. The large commission houses make it a practice to send representatives from time to time to the various pear-growing centers; consequently, the growers of these centers are able to keep in touch with market conditions much better than are isolated growers.

7. Class of Persons Growing Pears in the Locality. With the exception of controlling fire blight, probably less skill is required to grow pears than to grow apples. However, the susceptibility of the pear to fire blight and the destructiveness of the disease make it highly important that it be controlled;

and this is possible only where the disease is understood and intelligently combated. For this reason, the class of persons engaged in the growing of pears in a locality is of considerable importance in affecting the desirability of the locality for pear orcharding. In one of the great Oregon pear districts, the pear orchards of an entire county were menaced by fire blight simply because a few growers refused to accept the fact that fire blight is a bacterial disease.

Fortunately, at the present time it is not so difficult to convince growers of the necessity for combating blight as it was formerly. Before establishing an orchard, however, it would be well for a grower to become informed regarding the class of persons engaged in the industry in the neighborhood. If the growers are ignorant and disinclined to accept new ideas and practices it would probably be inadvisable to plant an orchard in the locality.

8. Climatic Conditions.—From a climatic standpoint, the ideal location for a pear orchard is a region where there is plenty of rainfall, where the temperature in summer does not become extreme, and where frosts do not occur when the trees are in bloom. If a region is too dry the trees will not thrive unless irrigated. Excessive heat in summer makes the handling of summer and early fall pears extremely difficult. The likelihood of frosts occurring when the trees are in bloom, is, obviously, a strong point against a region as a location for an orchard. In the United States, the best climatic conditions for pear growing are found in the northern tier of states and in certain of the Western States, particularly Washington, Oregon, and California. In many of the semiarid regions where irrigation is necessary to grow the trees and the temperature becomes very high, it is often difficult to control fire blight. Pears can, of course, be grown under a wide range of climatic conditions, but they will do best where the conditions previously mentioned prevail.

CHOOSING OF A SITE

9. The selecting of a suitable site for a pear orchard is an extremely important point. The general location may be well adapted to pear growing and good varieties for the locality may be chosen, but if the immediate site is not suitable, failure will result. In the selecting of a site, the following points should receive consideration: The nature of the soil, the elevation, the exposure, and the water and air drainage.

10. Soils for Pear Orchards.—The kind of soil that is best for pear growing depends largely on the region and on the variety that is to be grown. In New York State pears thrive best on clay loams, and in Pennsylvania they do especially well on alluvial soils. In Maryland, where a large number of Kieffers are grown, pears do well on sandy soils and, in some cases, on clay soils. Growers in most of the Southern States prefer rather poor soils, the light loams being chosen because of the fact that trees will not make such profuse growth on them as on strong soils, and consequently will be less subject to fire blight. In Indiana, pears thrive best on clay loams and suffer less from blight if the soil is poor. Michigan growers prefer clay loams. In Illinois, the trees seem to thrive best on rich, black soils, but on such soils they are likely to be killed by blight. In Oregon, pears do well on a variety of soils ranging from the heaviest adobe, on one hand, to the lightest granitic soil, on the other hand. In general, it may be said that in the northern tier of states clay loams seem to be the best soils for standard pears; that in the Southern and the Middle-Western States the unfertile loams are preferred; and that in the Western States soils that are neither very rich nor very poor are considered the best. Dwarf pear trees develop a fibrous root system and consequently thrive best on a rich, moist soil that has a subsoil of porous clay.

In localities where the rainfall is light in summer and where water is not available for irrigation, it would not be wise to plant an orchard on soils that will not hold moisture. For example, on the Pacific slope, where there is a dry season, it

would not be advisable, unless water for irrigation is available, to plant pear trees on land that has a subsoil of sand, coarse gravel, or hard rock. Even though irrigation water is available, the presence of gravel near the surface of the ground is likely to make irrigation out of the question. Pears will often thrive on ground where the subsoil is a stiff clay or hardpan, provided the subsoil is overlaid with from 30 to 40 inches of suitable top soil, but if the soil is thin, a subsoil of this character will render land undesirable for pear growing. In some sections, pear trees thrive on soil that is underlaid with disintegrating rock, the trees apparently living on the disintegrated material.

On the Atlantic seaboard, depth of soil is not as essential in pear growing as it is on the Pacific slope. This condition is due to the fact that during the growing season there is more rainfall in the Eastern States than in the Western States, and consequently there is less need for conserving moisture.

Different varieties of pears seem to do better on certain kinds of soil than on others. The Bartlett, the Comice, and the Howell probably do best on light loams. The Bartlett is a pear of remarkable adaptability, however, thriving on a great variety of soils and under a great variety of conditions. The Anjou, the Bosc, and the Winter Nelis seem to do best on strong loams; unless the Winter Nelis is grown on soil fairly rich in plant-food, the fruit will, in time, become very small.

11. Elevation for Pear Orchards.—It would be impossible to state that there is a definite elevation at which the pear will thrive better than at any other. In the Rocky Mountain States, particularly Utah and Colorado, pears are grown successfully at as high an altitude as 4,000 feet above sea level; in the Pacific Coast States they do best when grown at an altitude of less than 2,000 feet; in the Middle Western and the Eastern States most of the commercial orchards are at a comparatively low elevation; and in many of the Southern States the higher altitudes seem to be better for pears than the lower altitudes, as the trees make a more desirable growth. From these statements it may be seen that the best altitude for pears

varies with the locality. The indications are that pears, at least certain varieties, will not thrive on as high elevations as will apples.

12. Exposure for Pear Orchards.—If summer or fall varieties are to be planted, a southern slope is the most preferable one to choose, as a southern exposure is conducive to early ripening. However, in frosty localities a southern slope is somewhat objectionable, because the trees are likely to bloom so early that frost will damage the fruit crop, and in addition, the trees may be injured by sun scald. In regions where frosts are to be feared, a northern or a western exposure is the most preferable. If a locality is free from frosts it makes very little difference what exposure is chosen.

13. Water and Air Drainage for Pear Orchards. Water drainage is perhaps not as important in the case of the pear as in the case of the apple, nevertheless the pear requires land that is fairly well drained. Trees that are grown on water-logged land are low in vitality and consequently succumb easily to insect pests and plant diseases. In addition, trees grown on wet soil are not likely to bear well.

Air drainage is very important in the case of the pear, owing to the fact that the trees bloom early and are very susceptible to frost injury. However, on even gently rolling land it is likely that the air drainage will be sufficient. In very high altitudes it is often of advantage to choose a site in the vicinity of a cañon, as the cañon breezes will afford considerable protection from frosts. Pear orchards should not be planted on low, flat areas, or on level areas at the immediate base of high elevations, as such sites are likely to be frosty.

CHOOSING OF VARIETIES

14. The selecting of suitable varieties of pears for a particular locality is a point that is of much more importance than it was formerly thought to be. Varieties differ considerably in their adaptation to different regions. Some varieties do not develop well under certain climatic conditions; others

do not do well on certain soils. In the New England States and in most of the Northern States such varieties as the Bartlett, Bosc, Anjou, Flemish, Seckel, Lawrence, Sheldon, Clairgeau, and Angouleme are the leaders. In the Southern States and in many parts of the Middle West the Kieffer, LeConte, and Garber are becoming the leading varieties. On the Pacific coast, where pear growing has become commercialized more than in any other part of the country, a great many varieties are found. In California the Bartlett, Anjou, Comice, Howell, Winter Nelis, and Patrick Barry are the most popular varieties. In Oregon and Washington the leading varieties at the present time are the Bartlett, Howell, Clairgeau, Anjou, Comice, and Winter Nelis, but the Glout Morceau, Hardy, and Patrick Barry are rapidly increasing in popularity.

In the discussion of the status of pear growing in the different states, mention is made of the varieties that are in greatest favor in each state. This should give a general idea of the varieties that are adapted to a general locality, but before planting an orchard it is a good plan for a grower to ascertain from his state experiment station the most desirable varieties for his particular location.

PROCURING OF TREES

15. It is not, as a rule, advisable for a grower to attempt to propagate his own trees. Considerable skill is required, especially in budding, and besides, it will usually prove to be more economical to purchase the trees. Notwithstanding this fact, however, it is well for a grower to know something of the way in which pear trees are propagated.

16. Propagating of Trees.—Standard pear trees are propagated by grafting or budding the variety desired onto seedling-pear stocks. A few years ago practically all of the pear seedlings used in this country were grown in France. In many cases seeds were collected in this country and sent to France for the production of seedlings, which were subsequently returned to America. One reason for this was that the

American nurserymen had a great deal of trouble with leaf blight and other diseases, which attacked the seedlings. Another reason was that the seedlings could be produced cheaper in France than in America. At the present time, however, a great many seedlings are produced in this country, American nurserymen having learned how to combat the diseases and how to grow seedlings economically. Formerly, nearly all of the seed used for the production of seedlings was that of the European pear. Of late years nurserymen, particularly those of the Pacific coast, have been using for this purpose seed of the Oriental pear. The present popularity of Oriental pear stock is due to the fact that it is more resistant to fire blight than European pear stock, and that the trees make excellent growth in the nursery.

For the production of seedlings, plump, well-developed seeds from vigorous, healthy trees are selected. The seeds are stratified in the fall and kept there until time to plant them in the spring. When the ground has become warm enough for the planting the seeds are sown in rows wide enough apart for cultivation. It is important that the ground be kept fairly moist, otherwise the seeds will not germinate. As soon as the seedlings come up they are cultivated, the cultivation being continued at frequent intervals throughout the summer. Pear seedling form a long tap root with a few, if any, side roots. For this reason they are usually taken up in the fall and the tap roots are cut back so that they are not more than from 6 to 8 inches long. After this cutting back of the roots, the trees are either replanted in nursery rows and earthed up to prevent winter injury, or, preferably, are heeled-in in a frost-proof cellar. In the spring, the trees are transplanted to a new location. By the following August, in most of the Northern and Pacific Coast States, the trees can be budded; in the Southern States, budding can usually be done during July.

In the case of standard trees, budding is practiced much more extensively than grafting. Grafted trees do not seem to grow as well as budded trees, consequently they are not in as great demand. Either budding or grafting may be accomplished in the same way as with apples.

Varieties such as the Kieffer, Garber, and LeConte, which belong to the Oriental group of pears, can be propagated by means of cuttings, this method being extensively used in the South.

Dwarf pear trees are propagated by budding or grafting the pear onto quince stock. Some varieties do not unite well with the quince, however, and in the case of these it is necessary to double-work the trees. This process consists of budding or grafting the quince stock with a variety of pear that is known to unite well with the quince; then when the resulting tree has grown to a sufficient size it is top-worked to the desired variety. Formerly, the Angouleme was the principal variety used for the first budding or grafting, but at the present time the Koonce is considered the best variety for this purpose.

17. Purchasing of Nursery Trees.—If a person desires to purchase pear trees he should, if possible, make a tour of the available nurseries in order to examine the stock. If this is done he will be able to select trees that are free from serious insect infestations and fungous diseases, and that have good root system. In most states there are laws that prohibit the sale of trees affected with certain of the destructive insect pests and fungous diseases, but unless the purchaser knows the reliability of a particular nursery, it is a good plan for him to examine the trees before buying.

There is a growing tendency on the part of orchardists to plant younger and smaller trees than were formerly in demand. A few years ago, growers preferred 2-year-old trees, but at the present time the greatest demand is for 1-year-old trees. In the case of 1-year-old trees a grower has a much better opportunity to form the tops than in the case of 2-year-old trees, and in addition, trees planted when they are 1 year old retain more of the root system and make a better growth than trees planted when they are 2 years old.

Many persons when buying nursery trees make the mistake of purchasing the largest ones they can obtain. It is always best to purchase well-grown and well-matured trees rather than overgrown trees on the one hand or stunted trees on the



FIG. 1

other hand. Many of the overgrown trees are soft. The sap does not go down rapidly enough in the fall and consequently the trees are susceptible to winter injury or even to injury from cold periods in the autumn. Much of the trouble that is experienced with 1-year-old trees may be attributed to improper methods of handling after the trees are received from the nursery.

In selecting trees, care should be exercised to choose those that are thrifty, clean, and of medium growth. It would not be safe to say that only straight trees should be purchased, as those of some varieties, such as the Winter Nelis and the Bosc, are usually very unshapely while they are in the nursery and often even until they come into bearing. It is extremely desirable to procure trees that are well supplied with buds, as in this case the grower will be able to prune so that the branches will be properly spaced. Fig. 1 shows desirable 1-year-old trees; in (a) is shown a Comice tree and in (b) is shown a Winter Nelis tree.

18. If a grower desires to procure trees from a nursery he should place his order early so as to avoid any possibility of disappointment. When the trees arrive at the railroad station, if they are shipped, the grower should get them promptly in order to be sure that they will not be injured. The trees should then be heeled-in until time to plant them. It is desirable, in heeling-in the trees, to have the tops point toward the south; this is especially important if the planting is to be done in the spring, as the trees will not be as likely to start to grow as if the tops pointed toward the north. If considerable time is to elapse from the time the trees are received until they are planted in the orchard, it is best to heel them in singly rather than in bundles. Trees heeled-in singly are not so likely to be injured by scald as those heeled-in in bundles. The soil should be tamped firmly about the roots, and if there is danger of very cold weather, it is advisable to scatter a little mulch, such as decayed leaves or straw, on the ground around the trees.

PLANTING OF TREES

19. Time for Planting.—Where the climatic conditions are suitable it is better to plant pear trees in the fall than in the spring. Fall planting has the advantage over spring planting in that the trees become firmly established in the soil before winter sets in and are thus able to start growth in the spring before the ground can be put in condition for spring planting. This is an important advantage, as the trees make a good growth in the early part of the season before summer droughts occur. In many localities, however, it is not advisable to plant pear trees in the fall. If the winter temperature of a locality becomes very low at times, such as zero or lower, fall-planted trees would be likely to sustain injury the first winter from freezing of the roots. In general, it may be said that if there is any doubt as to the best time to plant trees, it is a good plan to choose the spring. In the case of fall planting the trees may be planted any time from late fall to almost spring. If spring is chosen as the time for planting, the trees

should be set in the ground as early as it can be got in proper condition.

20. Preparing of the Soil.—The pear will grow on more poorly drained land than the apple, but nevertheless it will not do well unless it has fairly good drainage. If the land is poorly drained the trees will be low in vitality and will not produce well. It is doubtful, however, whether it is advisable to plant pear trees on land that requires systematic drainage over the entire area, as plenty of good land for pear growing can be obtained that does not need much, if any, draining. In case some draining is necessary, the tile should be laid fairly deep, from $4\frac{1}{2}$ to 5 feet being, as a rule, a good depth.

It is important that land for pears be thoroughly prepared before the trees are planted. If the planting is to be done in the spring and the soil is stiff, it is advisable to plow the ground in the fall, especially in climates where there is considerable freezing in winter, as the alternate freezing and thawing will pulverize the soil. Fall plowing is advantageous, too, in regions where there is danger of summer drought, as the soil will absorb a great deal of moisture that will be of value during the growing season. Of course, if it is not convenient to plow the ground in the fall for spring planting, the plowing can be done early in the spring. If the planting is to be done in the fall, the plowing should be done a sufficient length of time before the trees are to be set to allow of getting the land in proper order.

The depth to plow depends largely on the nature of the soil. In the case of soils that are light and mellow and do not have a stiff-clay subsoil, less preparation will be required than in the case of heavy soils. An excellent plan in the case of extremely heavy soils is to plow the ground in lands, leaving the dead furrows where the rows of trees are to be set. It is well to break up the bottoms of the dead furrows by running a subsoil plow through them two or three times. This method affords a good tilth under the trees and provides a measure of under-drainage. Under average conditions it is advisable to plow from about 8 to 9 inches deep, if possible, and harrow the ground well before planting.

When the planting is to be done in spring and the land has been plowed the previous fall, the soil should be thoroughly worked in the spring until it is in good condition. For this work a disk harrow, a spring-tooth harrow, a clod crusher, or a roller may be used. If the ground is lumpy a corrugated roller can be used to advantage.

In some sections it may be desired to strip areas of their timber and to prepare the land for pear planting. In this case the stumps should be removed by dynamite or some other means and the ground worked down thoroughly before the planting is done. If the soil is very loose and rich, it is advisable to grow other crops on the land for 2 or 3 years; if pears are planted on soil that is very rich the trees will make too rapid growth and consequently will be very susceptible to fire blight.

21. Distance for Planting.—There is no specific distance at which pear trees will do better than at any other distance, consequently the distance for planting is largely a matter of personal opinion. Some of the most experienced growers have found that a good distance for planting standard pears is 15 feet apart in the rows, the rows being 30 feet apart. The object of planting thus is to obtain large crops of fruit from the ground until the trees become large enough to interfere with each other, when each alternate tree in the rows is cut out, leaving the trees a distance of 30 feet apart. In case it is not desired to use pear fillers, a good distance for planting is 20 to 22 feet apart each way.

Dwarfs are sometimes planted 10 feet apart each way, but 15 feet each way, or 193 trees to the acre, is better. This distance gives room to drive through the grounds for spraying and gathering the fruit.

The various planting systems such as the square, the quincunx, and the hexagonal, which have already been described in a previous Section, may be used also in the case of the pear. The grower can choose the system that he prefers.

22. Arrangement of Varieties.—In commercial pear orcharding there is a tendency to plant the trees in large blocks,

leaving out a row here and there to provide driveways. Growers often go to an extreme in this, however, planting single varieties in large blocks only to discover when it is too late that the trees will not set fruit well, due to self-sterility. The matter of pollination is an important point to consider in arranging the varieties in a pear orchard.

TABLE I
BLOOMING PERIOD OF DIFFERENT VARIETIES OF PEARS

Variety	Date of First Bloom	Date of Full Bloom
Clairgeau.....	April 6	April 13
Kieffer	March 29	April 11
Lawrence	April 6	April 14
LeConte	March 29	April 8
Anjou	April 8	April 13
Angouleme	April 9	April 15
Bloodgood	April 8	April 14
Tyson	April 9	April 18
Clapp Favorite.....	April 8	April 16
Flemish	April 10	April 15
Howell	April 8	April 15
Patrick Barry.....	April 8	April 18
Seckel.....	April 11	April 16
Winter Nelis.....	April 9	April 20
Lincoln.....	April 6	April 16
Mt. Vernon.....	March 29	April 11

It is impossible to divide pears into arbitrary classes with reference to their capacity for self-pollination. A variety that, in one locality, is self-sterile may, in another locality, be self-fertile. For example, in most parts of the East the Bartlett seems to be self-sterile but on the Pacific coast it is generally self-fertile. However, all varieties have a tendency either to be self-sterile or self-fertile. The following common varieties are more or less self-sterile: Angouleme, Anjou, Bartlett,

Clairgeau, Clapp Favorite, Howell, Lawrence, Sheldon, and Winter Nelis. Common varieties that have a tendency to be self-fertile are: Bosc, Seckel, Angouleme, Flemish, Kieffer, and LeConte.

The best plan in planting pears is to choose at least two or three varieties, the blooming periods of which overlap, and plant these in oblong blocks of four rows each. This will insure proper pollination. Mr. C. I. Lewis, of the Oregon Agricultural Experiment Station, has collected data regarding the average date of the first bloom and of full bloom of the common varieties when grown in Oregon. Table I gives this data. The blooming time of a particular variety varies, of course, in different localities, but the variation is much the same in the case of all other varieties.

23. Preparing of Trees for Planting.—If pear trees are planted in the fall, winter, or very early spring, the tops should not be pruned until the trees start to grow. If the tops are pruned at the time of planting, the trees may suffer

from dieback or may lose buds that are essential to the development of a good framework. In case the planting is done in late spring after danger of freezing is past, the tops of the trees may be pruned at the time of planting.

Considerable difference of opinion exists as to the proper method for trimming young pear trees when they are set. Different trees require considerably different trimming; consequently, it is impossible to give specific instructions for the operation. As a rule, dwarfs and small 1-year-old trees are trimmed to a whip, which is headed back to about a 2-foot length, as shown in Fig. 2 at *a*. Large 1-year-old trees and 2-year-old trees are cut back to a length of 25 inches or more, depending on the size and form of the tree,

FIG. 2 and all but from three to five of the best branches that are retained are cut back to short lengths. This method of trimming is illustrated in Fig. 3; in (*a*) is shown a large 1-year-old Comice tree before pruning; in (*b*), a 1-year-old Comice tree





FIG. 3



FIG. 4



FIG. 5

after pruning; in (c), a 2-year-old Winter Nelis tree before pruning; and in (d), a 2-year-old Winter Nelis tree after pruning. In Fig. 4 (a) is shown a 2-year-old Bartlett tree before pruning; in (b), a 2-year-old Bartlett tree after pruning; in (c), a 2-year-old Comice tree before pruning; and in (d), a 2-year-old Comice tree after pruning.

The roots of pear trees should be pruned at the time of setting the trees. All decayed and broken roots should be removed, and the long roots should be shortened, from about one-third to one-half of the root system being removed. Fig. 5 illustrates the method of pruning roots; in (a) is shown the roots of a Winter Nelis tree before pruning; in (b), the roots of a Winter Nelis tree after pruning; in (c), the roots of a Comice tree before pruning; and in (d), the roots of a Comice after pruning.

Pear trees are set in the ground in much the same way as apple trees, the ground being staked as described in *Apple Culture*, Part 1. It is advisable, when possible, to have all of the stock at hand before the planting is begun, so that if it is necessary to discard any trees it can be done at the outset and new trees ordered to take the place of those not desirable for planting. As pears are generally planted on clay soils, it is better not to dig the holes until just before the trees are to be set. If the soil is very stiff, fairly large holes should be dug, and if it is available, good top soil should be placed in the bottom of the holes. Although on certain soils it might pay to put some water in the holes when the trees are planted, this is never done in the case of commercial orchards. When only a few trees are planted, however, this can often be done to advantage. Standard trees should generally be set about 2 inches deeper than they were in the nursery, and great care should be taken to set them firmly, as loosely-set trees often die. Dwarf trees are usually planted so that the union is about level with the surface of the ground, so that when the soil settles the union will be a little above the ground.

PEAR-ORCHARD MANAGEMENT

TILLAGE OF PEAR ORCHARDS

TILLAGE OF YOUNG PEAR ORCHARDS

24. Young pear orchards are cultivated for about the same purposes and in much the same manner as young apple orchards. In the case of pear orchards, however, more care must be taken not to overstimulate the trees by too much cultivation than in the case of apple orchards; overstimulation of young pear trees results in a sappy growth of wood, which renders them very susceptible to attacks of fire blight.

As a rule, a young pear orchard should be plowed each spring, although if the soil is very light, disking may be practiced occasionally instead. The disking of orchard ground as a substitute for plowing is not, however, practiced as extensively as it was a few years ago. In soils of good tilth that are not underlaid with a stiff-clay subsoil, the roots of the trees will have a tendency to grow downwards and plowing, if commenced when the trees are young and kept up for several years, will remove only a few of the surface roots, thereby encouraging the remaining roots to grow deeply into the ground, a condition that is desirable. In case the soil is underlaid with a stiff-clay subsoil, however, the roots will not grow deeply into the ground but will extend laterally through the upper soil; in such cases plowing may cut and break off so many roots that the trees will be injured. Under such conditions it would undoubtedly be advisable to disk the ground rather than to plow it.

25. It is important for young pear trees to make a steady growth, especially in spring and early summer. This growth should not be a puny, sickly one on the one hand, or an

over-luxuriant, rapid one on the other hand. In order to secure a desirable growth, careful attention must be given to the orchard in the spring. On heavy soils it is a good plan to start the plowing as soon as the ground can be worked. On light soils plowing should not be started until the weather has become settled, as early plowing in the case of such soils tends to start the trees into activity, causing the sap to rise, which may result in sun scald, sour sap, or other troubles. The plowing, in either case, should be rather deep.

After the ground has been plowed the soil should be worked into good condition. In the case of heavy soils it is often a good plan to work the ground with a disk harrow soon after plowing in order to prevent baking of the soil. A spring-tooth harrow will be found to be of value where there is considerable turf, or sod, that must be torn to pieces after plowing. A spike-tooth harrow is effective for pulverizing heavy soils. A smoothing implement such as the Acme harrow or the Kimball weeder is very desirable for orchard work; the Kimball weeder is a favorite implement on the Pacific coast. For mashing clods and leveling the surface of the ground, the common drag is useful. If a drag is used it is a good plan to make it in two sections and fasten these together side by side, as when made in this way a drag will not have a tendency to level merely the high places. An implement that is rapidly coming into use on the Pacific coast for orchard cultivation is the corrugated roller. This implement grinds up the soil and pulverizes it very efficiently. It will save a lot of work, especially in the case of clay or adobe soils.

After the ground has been got in order all that will be necessary, in case intercrops are not grown, will be to harrow it at frequent intervals throughout the season. The number of harrowings to give will depend on the soil, climatic conditions, etc. In general, the ground should be harrowed sufficiently often to prevent weeds from growing or the ground from baking. In dry regions, great care should be given to the ground during June and July, so that weeds and baking of the soil will not cause moisture to be lost. However, if it is possible to cease cultivation by the middle of July or the first of August it should

be done. There is no advantage to be gained by cultivating young trees after they have made desirable growth and there are many disadvantages. If cultivated further the trees will be encouraged to make more wood growth, which is not wanted. It is best to have the trees get into winter condition as early as possible.

If a pear grower desires to grow other crops between the rows of trees as a matter of economy, this may be done for a few years after the trees are set without any detriment to the orchard, provided the crop is such as to require thorough cultivation. To grow among the trees the first season after planting there is no better crop than corn. It requires thorough cultivation and affords a shade to the young trees at a season when they most need protection from the heat of the sun. Other crops, such as potatoes, cabbage, peas, beans, melons, etc., may be grown to advantage. Small grain or grasses which do not require cultivation should not be allowed in a newly planted orchard. All these crops take from the soil plant-food that is needed for the orchard.

TILLAGE OF BEARING PEAR ORCHARDS

26. As soon as a pear orchard comes into bearing the growing of intercrops should be discontinued. As a rule, the orchard should be plowed in early spring to warm up the soil and to facilitate the storage of moisture from spring rains in the subsoil below. Even greater care should be taken not to injure the roots of bearing trees than is needed in the care of young trees. Shallow surface tillage should be maintained throughout the season by means of harrows or other stirring implements.

SOD AND MULCH CULTURE

27. Sod Culture.—Although it is usually advisable to practice clean tillage in the case of pear orchards, there are certain conditions under which it might be advisable to put an orchard in sod. In many parts of the Eastern and Middle Western States, especially, pear trees tend to make a very

rapid growth and consequently are extremely susceptible to attacks of the fire blight. In such a case sod culture is to be recommended, as it will tend to retard the growth of the trees. Also, many pear orchards are planted on steep hillsides where, if clean tillage were practiced, considerable erosion would occur. Under such conditions, sod culture would be much preferable to clean tillage. In all cases where sod culture is practiced, however, a sufficient growth of grass should be secured to maintain a thick mulch.

28. Mulch Culture.—When pears are planted on very heavy soils, mulch culture is often particularly advantageous. For example, on the Pacific coast, where pears are often grown on heavy adobe soils that are sticky and hard to handle, it is likely that in many cases mulching is the most effective and economical method of soil management. However, before adopting the mulch-culture system, a grower should experiment on a small part of his orchard in order to ascertain whether or not the system is satisfactory.

29. Catch Crops and Cover Crops.—The use of catch crops and cover crops in orchards has already been discussed in *Apple Culture*, Part 2. The information given in the Section referred to applies also to pears; consequently, it need not be repeated here.

PRUNING OF PEAR TREES

30. The principles that underlie the pruning of the pear are not materially different from those that underlie the pruning of the apple. In the case of each the relation of bud development to fruiting is almost identical and the principle of building a strong, sturdy tree the first few years is the same. It is commonly believed that pear trees do not require as much pruning as apple trees, many persons holding to the belief that pear trees should not be pruned at all. It is true that the pear tree has more of a tendency to assume a balance between the top and the root system than the apple tree, and that the former tends more to produce a crop annually than the latter. It is

true also that as color is not as important in pears as in certain varieties of apples, it is not as essential to prune the pear tree for the admission of sunlight to the fruit as it is to prune the trees of these certain varieties of apples for this purpose. Notwithstanding these facts, it should not be said that it is of less importance to prune the pear than it is to prune the apple.

The trees of varieties like the Anjou require fairly heavy pruning, especially during the first few years after they commence to bear. Trees of varieties like the Winter Nelis and the Bosc are difficult to prune during their early growth, as they grow very crooked and irregular. Some varieties have an upright habit of growth and some make a slender, straggling growth. All need attention each year.

31. Time for Pruning.—In most localities, pears are pruned in late winter or early spring. In parts of California and in some of the Southern States, however, pruning is done in the fall without any bad effects. In regions where cold periods occur it is advisable, in the case of young trees, to do the pruning in spring after growth has started.

The proper time for summer pruning varies from the middle of July to the middle of September, depending on the vigor of the trees. The Oregon Experiment Station has found, after limited experimentation, that the best time for summer pruning of pears, except the Bartlett, is late in the season when the trees are ceasing their vegetative growth and the terminal buds are becoming plump; the indications are that the best time to prune the Bartlett in summer is in June.

32. Methods of Pruning.—Most growers now favor the low-headed type of tree, which has already been discussed in a previous Section. Of this type of tree there are two forms, the pyramidal headed and the open headed, which, also, have already been described. Most pear growers at the present time prune for the open-headed form or some modification of it, as pyramidal-headed trees are difficult to manage in case they become infected with fire blight. Many western pear growers now favor what is known as the modified-center form of open-headed tree. A leader is allowed to grow for 2 or

3 years, so as to give a better distribution of the scaffold branches.

Pruning of the pear should be begun at the time of planting by cutting the young trees back, as has already been explained.



FIG. 6

This cutting back will cause several of the upper buds to grow, thus starting the top, or head, at the proper height. The young shoots should be watched and only such left to grow as are to form the main branches. Strong shoots that tend to grow obliquely outwards should be selected for retaining. At the beginning of the second year these shoots should be cut back to the extent of about one-half of their growth, as illustrated in Fig. 6, the lines showing where the cuts should be made.

The same plan of pruning should be continued the third and fourth years, about one-half of each year's growth being removed. Caution should be exercised, however, to study each tree; no arbitrary rule can be laid down for pruning trees. In Fig. 7 (a) is shown a 3-year-old Anjou tree before being pruned, and in (b) is shown a 3-year-old Anjou tree after being pruned.

Fig. 8 (a) shows a 4-year-old Bartlett tree before being pruned and (b) shows the same tree after being pruned. When the growth is cut back the top bud should be one on the side of the branch facing the direction in which the growth needs to be diverted; this will facilitate shaping the tree into the form desired.

33. When pear trees reach the bearing age, they should be pruned so as to keep them from becoming too rangy and dense. When trees tend to become rangy, the terminal growth of some of the leaders should be cut back to a strong lateral. If this method of pruning is followed there will be less likelihood of forcing out water sprouts and sucker growth than if all the leaders are cut back to the same length. If a tree tends to



FIG. 7

become too dense or the wood too spindling, some of the weaker wood should be thinned out. When trees have a tendency to make too much wood growth, it is advisable not to prune too heavily in the spring. The best plan is to prune pear trees moderately each year, so that excessive pruning will not be necessary. In Fig. 9 is illustrated a Comice tree before pruning. Fig. 10 shows the same tree after pruning. Summer

pruning is sometimes practiced in pear orchards for the purpose of overcoming the habit that the trees of some varieties have of



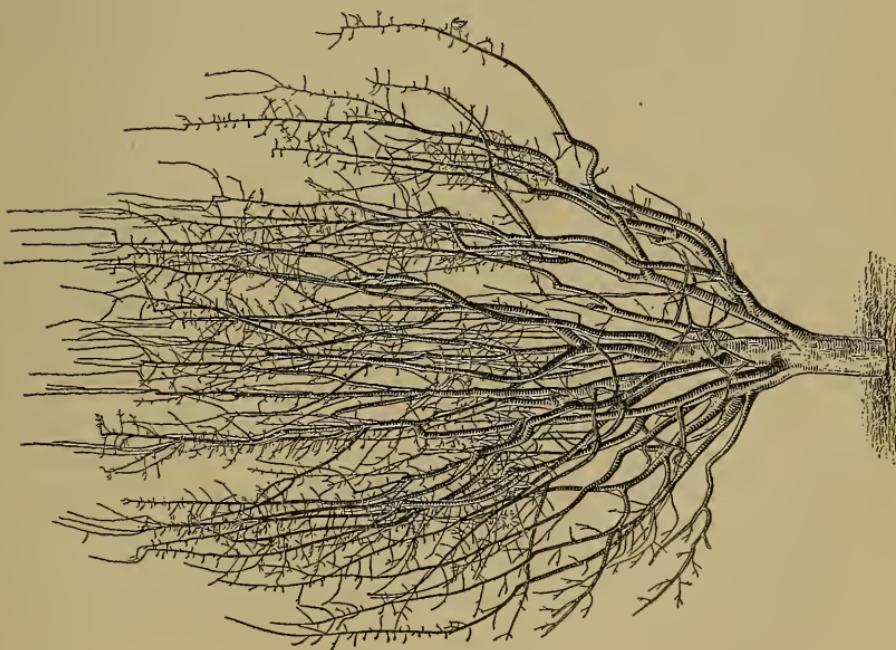
FIG. 8

bearing the fruit on the end of the twigs of the previous year's growth. It is also of advantage when the trees are growing too much wood at the expense of the fruit. If trees are pruned

FIG. 10



FIG. 9



in the spring and again in the summer the vegetative vigor can be greatly reduced. In summer pruning the usual practice is to remove from about one-third to one-half of the terminal growth of that season.

MISCELLANEOUS INFORMATION

34. Fertilizing of Pear Orchards.—Little attention has been paid by growers to the fertilizing of pear orchards, because the pear, as a rule, makes a too rapid growth even without fertilizer. In rare cases it may happen that, because of some unusual condition of the soil, the trees will not make a satisfactory growth or will not produce good crops. In such instances fertilizers may be needed to correct the defect. However, before applying either stable manure or commercial fertilizer to a pear orchard, a grower should conduct a fertilizer experiment. A simple experiment is as follows: (1) On one row or a part of one row sufficient to give accurate data, apply stable manure at the rate of 1 ton per acre, or nitrate of soda or high-grade dried blood at the rate of 75 pounds per acre. (2) On a similar area apply at the rate of 200 pounds per acre either muriate or sulphate of potash, or 1 ton of unleached wood ashes. (3) On a similar area apply at the rate of 350 pounds per acre a good grade of acid phosphate. (4) Apply on a similar area manure or nitrate of soda as recommended in (1) and muriate or sulphate of potash or wood ashes as recommended in (2). (5) Apply on a similar area manure or nitrate of soda as recommended in (1) and acid phosphate as recommended in (3). (6) Apply on a similar area potash or wood ashes as recommended in (2) and acid phosphate as recommended in (3). (7) Apply on a similar area the materials recommended in (1), (2), and (3). (8) Leave a row or a part of a row between each of the fertilized plots as a check plot. This experiment is much more simple than might be thought, as the fertilizer combinations are built up one from another and all of the fertilizer materials named are easily secured. In order to supply accurate data, the experiment should be conducted for several years.

The time and manner of applying manure or commercial fertilizer to a pear orchard are the same as in the case of the apple.

35. Thinning of Pears.—It is a mistake to allow pear trees to overbear, as the fruit will be small and the trees will be likely to develop a tendency to bear only in alternate years. All deformed, inferior, and insect-infested fruit, as well as perfect fruit that is less than from 4 to 6 inches apart on the limbs, should be removed from the trees. This thinning is usually done after what is known as the June drop, or during the last of June or the first of July. If pears are thinned the remaining fruit grows much larger than it otherwise would, and at harvesting time a grower will find that there will be more bushels of first-grade fruit on the trees than if the pears had not been thinned. Besides, the trees will be spared from bearing an excessive burden and will be more likely to bear a crop the next year.

36. Renovation of Neglected Pear Orchards.—If neglected pear trees are not too old and still have sound trunks they can often be brought into a state of profitable bearing. In case the orchard has not been plowed for several years it is doubtful whether it would be advisable to plow it, because if this were done the roots of the trees would likely be severely injured. In general, it may be said that if the orchard is in a region where it is difficult to obtain sufficient moisture, the orchard should be plowed, but otherwise sod or mulch culture should be practiced.

The tops of neglected trees should not be pruned too heavily at first, as this would result in a heavy growth of water sprouts, which would be unfavorable to fruit production. The best plan is to cut out all weak and diseased wood at the dormant pruning and head back the terminal growth moderately by summer pruning. If the trees are too high headed the branches should be cut back to a strong lateral. In case the trees are of undesirable varieties, they can be top-worked to the varieties desired.

SPRAYING OF PEAR TREES

37. The various diseases and insects of the pear, with their control measures, have already been discussed in the preceding Section. It is not the purpose here to repeat the information already given, but rather to present the different sprayings in chronological order. The following sprayings are recommended for the pear:

1. Just as the leaf buds are swelling but before they are open, spray with lime-sulphur solution of a specific gravity of 1.03, to which has been added 2 pounds of arsenate of lead to each 50 gallons of the spray solution. This spraying is for the control of the San José scale and the leaf-blister mite.

2. After the leaf buds are open, but just before the first blossoms open, spray with lime-sulphur solution of a specific gravity of 1.006, or with Bordeaux mixture made by mixing 4 pounds of copper sulphate, 4 pounds of lime, and 50 gallons of water. This spraying is for the control of the pear scab. The remedies for pear scab vary considerably in different sections; consequently, it is advisable for a grower to consult the nearest experiment station with reference to the control of this disease.

3. When the petals of the blossoms are still falling and the calyxes are still open, spray with from 2 to 3 pounds of arsenate of lead mixed with 50 gallons of the same lime-sulphur solution given in paragraph 2. This spraying is for the control of the codling moth, pear scab, and any other fungous disease present.

4. In case the pear psylla is present in the locality, spray, just after the blossoms have fallen, with dilute kerosene-soap emulsion, made by mixing 1 part of kerosene-soap stock solution and 6 parts of water; or spray with whale-oil soap made by mixing 1 pound of whale-oil soap and from 4 to 5 gallons of water; or spray with one of the tobacco extracts, using a 2.7-percent. nicotine preparation diluted with from 65 to 100 parts of water. This spraying is for the control of the pear psylla and should be repeated at intervals of from 3 to 7 days until the insects are under control.

5. From 10 to 14 days after the spraying described in paragraph 3, spray again with the same materials. This spraying is principally for the control of the codling moth and the pear scab.

6. The green aphid is controlled in the same way as in the case of the apple. This pest should be sprayed for as soon as it appears, before the leaves curl, and is easy to control if this rule is followed.

HARVESTING, STORING, AND MARKETING OF PEARS

HARVESTING

38. Picking of Pears.—It is often somewhat difficult to determine when pears are ready to be picked. If they are allowed to hang on the trees too long they will develop a high color but become mealy in texture. On the other hand, if pears are picked too soon they will shrivel and be deficient in flavor. Most pear growers make the mistake of allowing the fruit to hang on the trees too long. As a rule, as soon as pears can be snapped from the spurs by a gentle twist they are in the best condition for picking. Often growers pick their pears early by clipping the stems; this enables them to take advantage of high prices that prevail early in the season. If a person is experienced in picking pears this practice may be followed without injury to the fruit, but an inexperienced person is likely to sustain considerable loss. Pears may be clipped early if the picking is done at the proper time, but it is difficult to determine just what is the proper time.

About the same picking receptacles are used for pears as for apples. Any of the common receptacles will prove satisfactory, provided the picker exercises care in handling the fruit. When unskilled labor is employed, however, it is advisable to provide receptacles that will minimize, as much as possible, the likelihood of the pears being injured. A desirable form of receptacle, under such conditions, is the common galvanized-iron pail. Another good receptacle is a basket provided with a

bail. Pails and baskets prevent bruising of the fruit when the pickers are descending the picking ladders and besides, may be emptied with little injury to the pears.

A desirable form of picking ladder is the Japanese stepladder. The Japanese ladder is easy to handle and does not injure the trees like some other ladders. The common stepladder also is extensively used in the picking of pears. Whatever form of ladder is chosen it should be such as not to injure the trees; this is a very important point in the case of the pear.

As has already been stated, pears are generally picked by simply twisting them from the spurs. Pickers should be cautioned to handle the fruit with the greatest possible care, as even slight bruises may be very damaging. Pickers soon acquire the ability to judge size, which is essential to good picking. Inexperienced pickers often make use of a wire ring hung from the neck with a cord so that it can be readily applied to a pear; if the inside of the ring is made the size of the smallest pear to be picked, any pear that it will slip over without touching is too small for picking and should be allowed to remain on the tree until the next picking. The minimum size of pears to be picked will depend on the variety and on the locality. The trees are usually picked over a number of times until all of the pears have been harvested. In the case of some varieties like the Bartlett the picking seasons often last from 4 to 6 weeks.

For the transporting of pears from the orchard to the packing shed, crates such as those recommended for apples will be found satisfactory. A low wagon provided with springs can be used for hauling the fruit from the orchard.

Perhaps the best system for the management of pickers is to hire them by the day and pay them at the end of each week. It is essential that extreme care be exercised in the handling of pears, and for this reason it is not advisable to hire pickers at a certain rate per bushel, as in this case they are likely to do the work carelessly in order to pick a large quantity of fruit. Often it is a good plan to provide each picker with tickets or coupons, one of which is to be placed in each orchard box of fruit picked. This will enable the foreman to ascertain the quality of work that each picker is doing.

39. Grading of Pears.—It has been proved by experience that there is less profit in the grading of pears than in the grading of almost any other kind of fruit. Pears of the same variety that are grown under similar conditions are, as a rule, fairly uniform in size, and do not require much grading. Notwithstanding this statement, it will usually be found that simple grading is profitable. Obviously, pears that are undersized, infested with insects, deformed, or blemished in any way should not be packed with first-class pears. The grading that is required, however, can be done by the packer, a special assorting of the fruit not being necessary.

Most of the prominent growers and fruit associations sort pears into two grades known as *fancy* and *choice*. Following are the specifications of the Yakima Valley Fruit Growers Association for the two grades:

In order to be graded as *fancy*, Bartlett, Anjou, Comice, Flemish, Clapp Favorite, Clairgeau, and pears of kindred varieties must be not smaller than $2\frac{1}{2}$ inches in diameter; Winter Nelis pears must not be smaller than $1\frac{3}{4}$ inches in diameter. All fruit must be free from worms, insect stings, scale, picking bruises, blemishes, evidence of rough handling, scab, or deformity of any kind whatever.

Pears, in order to be graded as *choice*, must be sound, free from worms, insect stings, scale, and disease; slightly misshapen pears, or those showing limb rub or other like defects, may be included. No pears less than $2\frac{1}{4}$ inches in diameter, except Winter Nelis, shall be accepted. In fact, stock in this grade must be only a little below fancy.

40. Packing of Pears.—Pears are packed in a great many different kinds of packages. On the Pacific coast the pear box is the commonest package for fancy and choice fruit. The standard box is usually 18 inches long, $8\frac{1}{2}$ inches deep, and $11\frac{1}{2}$ inches wide; the half box is usually of the same width and length as the standard box but is only half as deep. A standard box when packed with fruit weighs approximately 50 pounds, and the half box about half as much. Kieffer pears are often packed in barrels and half barrels. Bushel baskets

also are commonly used in the East and Middle West for packing Kieffers; this form of package is popular for all varieties when the fruit is intended for local sale. In New York State, growers of Seckel pears often use a keg for packing the fruit. Sometimes pears are marketed in large Climax baskets, in which case they are generally packed in crates, or carriers, that hold a dozen or more of the baskets. In case pears are to be sold on the local market, and consequently do not have to be shipped, they are sold in bushel and half-bushel baskets, light barrels, etc.

41. Before being packed in boxes, pears should be graded to size and quality. Each pear should be wrapped in paper and placed in the box with the blossom end of the pear toward the end of the box. Each pear should be placed firmly in position and pressed down so that it fits snugly and cannot be shaken from side to side when the box is moved. Usually, a pear is picked up with the left hand from a box of loose pears, and paper from the paper rack is picked up with the right hand. The pear is placed in the paper in the right hand with one motion, the paper closed around the pear with both hands, and the pear placed in position in the box. The packer usually has a place near a window so that he can have plenty of light. Each packer is provided with a box of loose pears from which he packs, another box for culls, and two or three boxes that he is packing at one time.

Packing of pears in boxes has not been standardized as much as the box packing of apples. However, recently a number of the western fruit associations have adopted standards for box pear packs. In general, the packing of pears in boxes is so similar to apple packing, which has already been described in a previous Section, that a detailed discussion is unnecessary. The style of pack in general vogue is the diagonal pack. The number of rows, tiers, and layers will depend, of course, on the size of the pears. Perhaps the packs most often used are the 2-2, 3-2, and 3-3. Fig. 11 (a) shows a 2-2 pack; (b), a 3-2 pack; and (c), a 3-3 pack. The method of making these packs is the same as in apple packing.

In the case of pears, greater bulge is given to the box than in the case of apples; the bulge should, as a rule, be about $\frac{3}{4}$ inch at both the top and bottom. The boxes are often lined with paper, the top layer of fruit being covered with lace paper. The method of nailing the boxes is the same as described for apples.

When pears are properly packed in boxes they can be shipped any distance if handled and braced properly. The bulge is

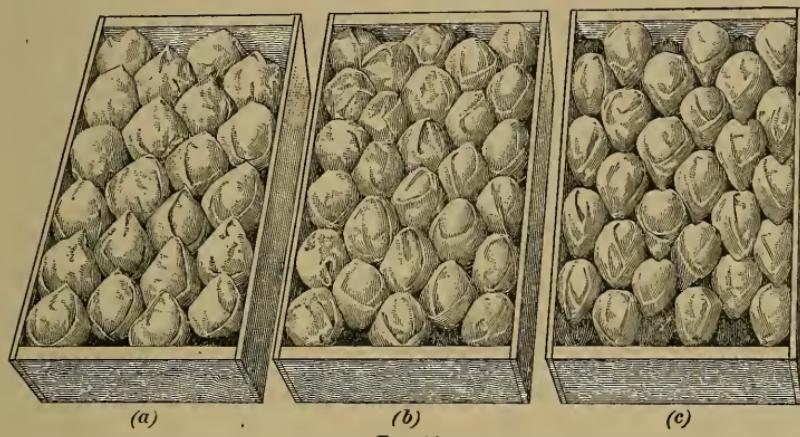


FIG. 11

only on the top and bottom of the box; consequently, the boxes should always be placed on their sides. This effectually prevents crushing of the fruit.

42. When baskets are used for packing, the top layer is usually arranged so as to give a neat appearance to the package. When carriers are used some effort is generally made to put the pears in regular order. If kegs or half barrels are used the pears are occasionally laid in individually, the stems pointing inwards and the calyxes toward the outside of the keg or barrel; sometimes this system is varied by placing the first row so the stems point inwards and the second row so that they point outwards. When barrels are used, about the only placing of specimens that is done is in producing the face of the barrel.

STORING

43. Because of the relatively small output of pears, not as much experience has been gained in the storing of this fruit as in the storing of apples. However, the experience that has been gained has proved that pears can often be as successfully and profitably handled in cold storage as apples. If pears are picked without injury, packed in a cool place, and stored where a sufficiently low temperature can be maintained, they can be kept for months. But if pears are bruised in handling and then exposed to a warm temperature in packing they will be almost sure to deteriorate if placed in cold storage. If pears are held at about 32° F., they seem to hold up much better than if they are held at a higher temperature. Also, if they are wrapped in paper, they will hold up better than if not wrapped.

Pears improve in quality, flavor, and lusciousness while in storage, provided they have been picked before ripening. Pears that have developed to a proper size on the trees, although hard and of seemingly poor quality for eating, will, in a few weeks or months, develop or ripen to their very finest condition.

Pears, like apples, can be maintained fairly well in home storage, that is, in cellars or in specially constructed storage houses. They should be wrapped in paper, as in cold storage. As a rule, however, pears cannot be kept much after Thanksgiving in home storage.

MARKETING

44. The pear is not as well known in fruit markets as the apple. This is largely due to small production, careless packing, and unfamiliarity on the part of the public with the best varieties. However, the pear is rapidly increasing in popularity and there is reason for the belief of many authorities that the marketing of pears at remunerative prices will become less difficult each year.

Pears are marketed in the same way as apples, consequently little discussion of this subject is necessary. Each grower must determine after a study of his own conditions whether

it will be more profitable to sell the fruit on the local market or to consign it to a wholesaler. In the case of large orchards, it is often the best plan to sell the entire crop to a buyer for a commission house. In the case of small orchards, the best prices can often be obtained by building up a special retail trade. A great deal of fruit is now being handled by associations, which sell to wholesale buyers, thus eliminating the local dealers. When fruit is handled in this way the grower must wait until the association receives pay for the fruit and can apportion it to each grower. This is because the association usually has a large number of small lots that must be sorted so as to ship as many pears of one kind, pack, and grade in one shipment as are required. In many cases it is an advantage to ship only one variety of pears in a carload lot.

Many growers make the mistake of shipping their pears to markets that are glutted with fruit or that do not have a demand for the particular variety or varieties the grower has to sell. It is always advisable to know as much as possible about the conditions and demands of a market before shipping fruit to it. This information can be obtained by corresponding with reliable dealers.

Fancy and choice pears should be put up in an attractive package and be properly labeled, so that the prospective customers will know where and by whom the fruit was grown. Cull pears can often be disposed of to canneries at prices almost equal to those obtainable for fancy and choice grades.

CHERRIES, APRICOTS, AND QUINCES

CHERRIES

CLASSES OF CHERRIES

1. For convenience cherries may be divided according to the acidity of the fruit into three classes—*sour cherries*, *subacid cherries*, and *sweet cherries*. There is, however, much overlapping, and often it is somewhat difficult to determine the class to which a variety belongs. The Pacific Coast States produce most of the sweet and subacid cherries that appear on the market. Recently, however, certain districts along the shores of Lake Michigan have begun to compete with the Pacific Coast States in the production of sweet cherries. Throughout the Middle West and in the Eastern States most of the cherries grown are of the sour varieties.

2. The **sour cherries** most frequently grown belong to two general groups: (1) the *amarelles*, which are light-colored cherries with slightly flattened ends and have a colorless juice; and (2) the *morellos*, which are dark-colored cherries of heart or of spherical shape and have a dark-colored juice. The number of new varieties of sour cherries is being increased by propagation from seed in the Eastern and the Central States and by importations from Russia and other parts of Europe.

As a class, the sour cherry trees are characterized by a low, round-headed type of growth and have the habit of suckering

from the roots; the flowers are in small clusters from lateral buds and generally appear before the foliage; the leaves are light or grayish green, are narrowed to a point, and are hard; the fruit is roundish and always red; the flesh is soft and sour.

3. The **subacid cherries** are those that cannot be called either sour or sweet and they belong to a small group known as the *dukes* group. The varieties of this group are believed by some of the best horticulturists to have originated from the crossing of sweet and sour cherries. In type of tree growth, in flowers and foliage, and in shape of the fruit the varieties of the dukes group resemble the sweet cherries, but in flavor the fruit resembles sour cherries more nearly than sweet, being subacid and in some cases fairly acid. The fruit of the dukes is heart shaped, excellent in flavor, juicy, and usually tender. However, the fruit is subject to rot and ships very poorly, and for these reasons the cherries of the dukes group are not grown so extensively as those of other groups. One very undesirable feature of this group of cherries is that all the fruit on a tree does not ripen at about the same time, the ripening period extending over a considerable length of time.

4. The **sweet cherries** grown in the United States belong to three groups: (1) the *mazzard* group, which includes the common native sweet cherries of the Eastern States and the mazzard seedlings that are imported from Europe and used by nurserymen for stocks; (2) the *heart*, or *gean* group, the fruit of which is usually heart shaped and has soft flesh; and (3) the *bigarreau* group, the fruit of which is heart shaped, hard fleshed, and of a light color, the typical fruit being light red on one side and whitish or lemon colored on the reverse side.

As a class, sweet cherry trees are characterized by having a tall-growing and erect habit and a bark that tends to peel somewhat like the bark of a birch tree; the flowers are flimsy and appear in clusters on spurs with the foliage; the leaves are large and usually limp and gradually taper to a point; the fruit is variously colored, and may be either spherical or heart shaped; the flesh may be either hard or soft and is generally sweet.



FIG. 1

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5. Important Varieties of Sour Cherries.—The following is a list of some of the important varieties of sour cherries, with a brief description of each variety:

The **Baldwin**, which is a variety of the morello group, is regarded as promising. The trees of this variety have stout, spreading tops and are good bearers. The fruit ripens in mid-season and is of good size and quality.

The **Brusseler Braune** is a variety of Russian origin. The trees of this variety are medium to large in size, upright in growth, and have long, slender branches. In some sections of the country the trees of this variety have been found to be poor bearers. The fruit, which is illustrated in the lower part of Fig. 1, is very late in ripening. It is medium in size and quality, and is astringent.

The **Dyehouse** is a variety of the amarelle group. The trees of this variety are not so vigorous as those of the Montmorency variety, which will be described later. The fruit of the Dyehouse is medium to small in size and light red in color. The flavor is slightly acid and the quality is very good.

The **Morello**, or *English Morello*, is, as the name indicates, a variety of the morello group and is one of the oldest and best varieties of sour cherries grown in the eastern part of the United States. The trees are medium in size, slender but spreading in growth, and are hardy. The fruit is medium in size, roundish in shape, and of a reddish-black color. It is very sour and slightly astringent. The flesh and juice are dark. The fruit is firm and has excellent shipping qualities.

The **Montmorency**, a variety of the amarelle group, is the standard variety of sour cherries grown in the United States. There are two strains of Montmorency, the *Long-stemmed Montmorency*, or the *Montmorency Ordinaire*, and the *Short-stemmed Montmorency*. The Short-stemmed Montmorency, however, is little grown in the United States. The Long-stemmed Montmorency is the one sold by nurserymen and is the one to which the following description refers. This is the variety desired by canners. The trees are hardy, good bearers, and come into bearing early. The fruit, which is illustrated in the upper part

of Fig. 1, ripens in mid-season, is of medium size and of a rich dark-red color. It is acid and very good in flavor.

The **Ostheim** is a variety of the morello group, and really consists of a number of strains. The variety has been grown in the United States for nearly a century. The trees are slender



FIG. 2

in growth but are very hardy. The fruit is large and round and of dark, reddish-brown color. It is juicy, medium acid in flavor, and moderately good in quality. The skin is tough.

The **Phillippe**, or *Louis Phillippe*, is a variety of the morello group. The trees of this variety are upright and spreading in

growth and are said to be productive. The fruit is medium to late in ripening, of medium size and good quality and is dark red in color. It is acid and has tender red flesh.

The **Richmond**, or *Early Richmond*, is a well-known variety of the amarelle group. The trees of this variety are hardy, vigorous, and profuse and regular bearers, but are inclined to be short lived. The fruit, which is illustrated in Fig. 2, ripens early or moderately early in the season. It is of medium size, light red in color, acid, very juicy, and rather rich in quality. The fruit keeps only a short time after being picked, and is therefore fit only for local-market and home use.

The **Suda** is a variety of the morello group. The trees of this variety resemble those of the English Morello but are more upright in growth. They are profitable bearers in some sections. The fruit of this variety can hardly be distinguished from that of the English Morello.

The **Wragg** is a standard variety of the morello group. The trees resemble those of the English Morello variety. The fruit also resembles that of the English Morello, but is a little larger and is somewhat later in ripening. By some authorities, this variety is considered identical with the English Morello.

6. Important Varieties of Subacid Cherries.—The following is a list of some of the most important varieties of the dukes group and a brief description of each variety:

The trees of the variety **Eugene** are upright in growth and fairly productive, but lack in vigor. The fruit of this variety is among the earliest to ripen and lasts over a long season. The fruit is medium to large in size, amber red in color, and has a fine flavor. The flesh and juice are dark.

The **Hortense**, or *Reine Hortense*, is a variety that is characterized by trees that are good growers and universal bearers. The fruit of this variety is among the largest of all cherries. It is heart shaped and of a beautiful glossy red, or a deep pink color. It is excellent for canning, but is too soft and juicy for shipment.

The **Magnifique** is a productive variety. The trees are upright and spreading in growth. The fruit is among the latest

of the cherries to ripen, and for this reason it is of value. The fruit is too small and of too light a shade of red to take well in the market. It is firm, juicy, and of mild flavor, but is not of the highest quality. The flesh is pale yellow in color.

The **May Duke** is one of the most popular varieties of the subacid cherries. The trees are hardy, vigorous growers, and productive. The fruit is among the earliest cherries to ripen and tends to ripen over a long season. It is large, of a dark-red color, very rich and juicy, of acid flavor, and excellent when ripe.

The **Montreuil**, or *Belle de Montreuil*, is a comparatively new variety. The trees are vigorous, free from disease, upright, spreading in growth, and productive. The fruit is glossy dark red, almost black. The flesh and juice is dark red. The fruit is medium in quality.

The **Olivet** is a variety that is frequently reported as unproductive. The trees, however, are strong, spreading growers. This variety was produced by a cross between a duke and a morello. The fruit is large and of a dark-red color. It ripens early, is of good quality, and is especially good for canning.

7. Important Varieties of Sweet Cherries.—

The following is a list and a brief description of some of the most important varieties of sweet cherries:

The **Bing** is a variety of the bigarreau group that is regarded as promising. The trees are strong growers. The fruit ripens in mid-season, is very large, almost black in color, firm fleshed, and of high quality.

The **Centennial** is a variety of the bigarreau group, and is said to be a seedling of the Napoleon, a variety that will be described later. The trees of the Centennial variety are vigorous, productive, and fairly hardy. The fruit is large in size and ripens late. In color, it is yellow, marbled with crimson. It is very sweet and is a good shipper. This variety is considered promising, especially on the Pacific coast.

The **Elton** is a variety of the heart group. The trees of the variety are good growers but in some parts of the country are found to lack in productiveness. The fruit ripens about

mid-season. It is very large, heart shaped, and of a pale yellow color with a red blush. The fruit is of the best quality, but is subject to rot and is therefore not a good shipper, although it is excellent for home use. The flesh is light colored and firm.

The **Lambert**, which originated in Oregon, is a variety of the bigarreau group. The trees are hardy, vigorous, and strong growers. The fruit is large to very large and heart shaped; in color, it is dark amber, turning to a dark red as the fruit matures. The flesh is dark, rich, firm, juicy, and of good flavor. The pit of this cherry is small for the size of the fruit.

One of the most popular sweet cherries is the **Napoleon**; also called the *Royal Ann*, a variety of the bigarreau group. The trees of this variety are strong and vigorous in growth and very productive. The fruit, which is illustrated in Fig. 3, ripens about mid-season. It is large and in color yellow shaded with red. The flesh is light colored, firm, juicy, and of good quality.

The **Rockport** is a variety of the bigarreau group. The trees are moderate to vigorous in growth. The fruit ripens between early and mid-season. It is large, heart shaped, and red shaded with amber. The quality is very good. The flesh is firm and juicy.

An old and well-known variety that does well under many conditions is the **Spanish**, or *Yellow Spanish*, which is a variety of the bigarreau group. The trees of this variety are strong growers and are productive. The fruit ripens from mid-season to late, is large, and of a pale, waxy-yellow color with a red blush. It is of good quality.

The **Tartarian**, or *Black Tartarian*, is one of the oldest and most popular varieties of the heart group. The trees lack in vigor and hardiness when compared with those of some other varieties of the group. The fruit, which is illustrated in Fig. 4, is very large, dark red in color, and mildly sweet. It is of good quality and generally brings high prices.

One of the new varieties that has made a good reputation is the **Windsor**, which is a variety of the bigarreau group. This variety originated in Ontario and some of the best growers have

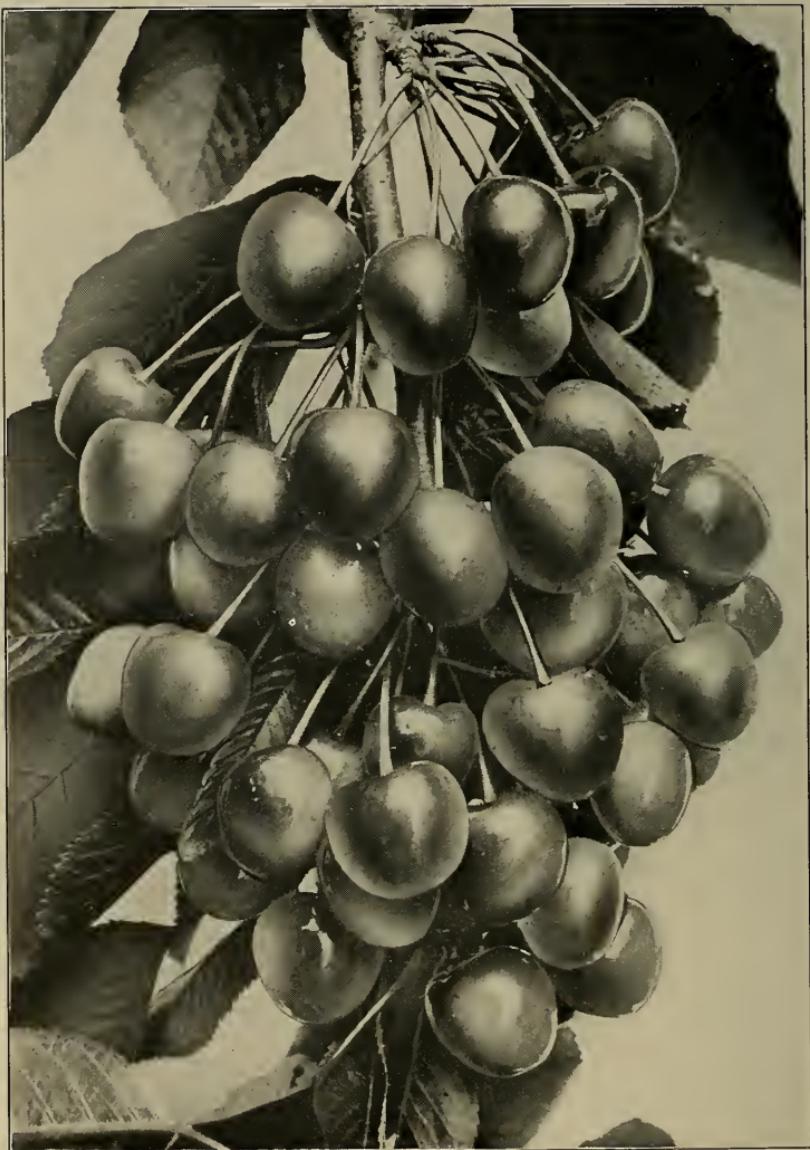


FIG. 3

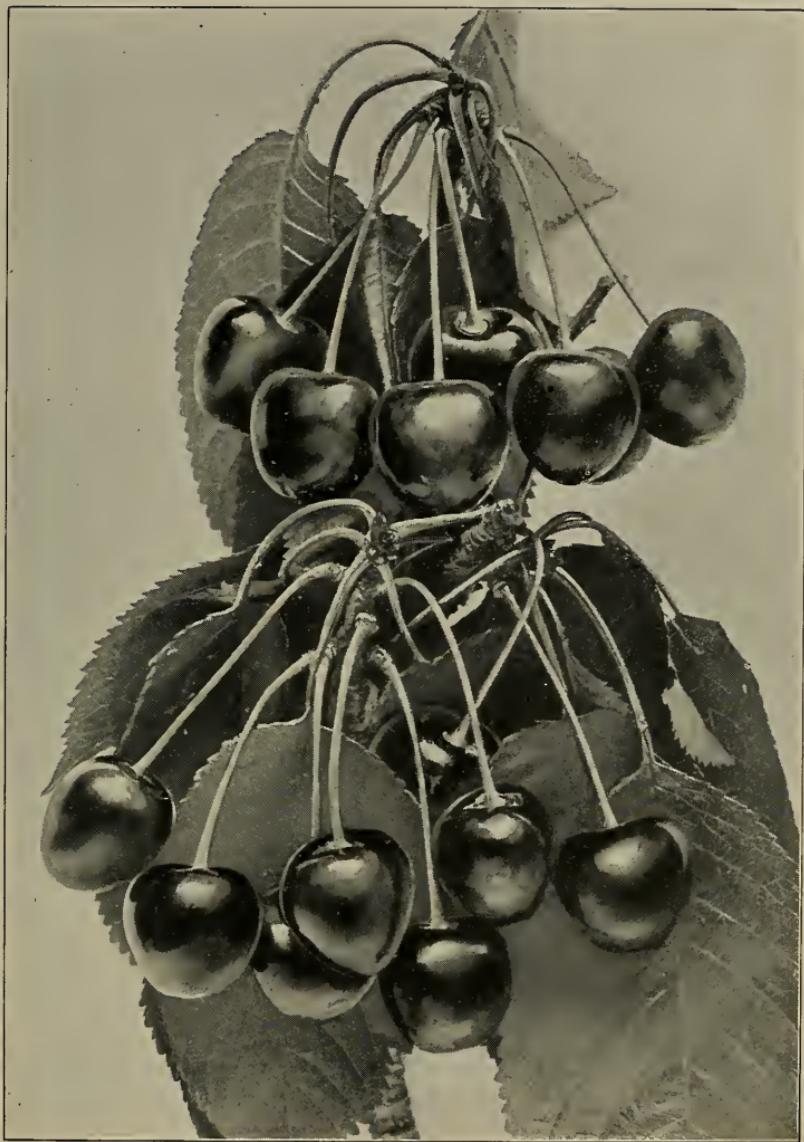


FIG. 4

recommended it as a variety that should be included in nearly all cherry orchards. The trees are hardy, vigorous, and very productive. The fruit tends to ripen late, is heart shaped, dark reddish brown, and of fine quality. The flesh is firm and of a dark-red color.

A variety that is recommended for home use and for near-by markets is the **Wood**, also called *Governor Wood*, which is a variety of the heart group. The trees of this variety are strong, vigorous growers, and are productive. The fruit ripens early, is medium to large in size, and in color is pale yellow with a reddish blush. The fruit is of good quality but is subject to rot. The flesh is tender and juicy.

CHERRY-ORCHARD ESTABLISHMENT

SIZE, LOCATION, AND SITE

8. Size.—Throughout the greater part of the country few cherry orchards of more than 10 acres in extent exist. In some of the Pacific Coast States, however, extensive orchards of sweet cherries have been under cultivation for some years. Recently some large orchards of sour cherries ranging in size up to 150 acres have been planted in Ontario and Quebec, in parts of New York and Pennsylvania, along the shores of Lake Michigan, and in the vicinity of St. Louis. One such orchard in Western New York consists of 50 acres of Early Richmond, 50 acres of Montmorency, and 50 acres of English Morello.

9. Location.—As has been said, the area in which cherries may be grown is widely distributed throughout the United States and Canada. There are, however, certain sections that are not adapted to the growing of cherries. In sections where the atmosphere is very dry, as on high plains, cherries cannot be profitably grown, because even if the trees make good growth they do not bear well. A point that must be considered in selecting a location for a cherry orchard is the availability of labor for harvesting the crop, which must be done in a comparatively short time.

The character of the soil must also be considered in selecting the location for a cherry orchard. The ideal soil for the sweet cherry is a deep, sandy loam. A clay subsoil may not interfere with the growth if the soil is well drained and the clay is not too compact. The soil should contain sufficient organic matter to retain moisture well, but it should not be too rich in nitrogen, as this will tend to stimulate a rank wood growth, which leads to exudation of sap and causes the tree to be unfruitful and short lived. The sour cherry will thrive on soil adapted to the growth of the sweet cherry and may also be grown with profit on well-drained clay loam.

10. Site.—The selection of a proper site for the cherry orchard is very important, as no other hardy fruit is so susceptible to injury by frost or cold rain during blooming time. Especially is this true of the sweet cherries.

The ideal site is a high elevation which has good air drainage as well as good water drainage. Such a site tends not only to lessen the danger of injury by late spring frosts, but also reduces the damage by brown rot. If the grower has a choice of equally desirable land sloping in different directions, a northern slope should be selected, as the opening of buds in the spring is retarded more than on other slopes. The proximity of large bodies of water also lessens the danger of late frosts.

SELECTION OF VARIETIES

11. In selecting the varieties of cherries to be grown in a commerical orchard, a grower should select from the varieties that have been successfully grown in that section. In the Pacific Coast States, sweet cherries are grown practically exclusively, and the following varieties have been recommended for growth in that region: Black Tartarian, Napoleon, Windsor, Yellow Spanish, Rockport, Elton, Bing, Lambert, and Centennial; of these the Black Tartarian and the Napoleon varieties probably stand first in importance. In the Sierra Nevada Mountains in the eastern part of Oregon, the dukes are widely planted, as they are more hardy and stand the winters better.

than the varieties just mentioned. In the Central West, sour cherries are planted almost entirely. The varieties most widely grown are Dyehouse, Early Richmond, Montmorency, English Morello, and Wragg. In the Eastern States, sour cherries are largely grown, although some sweet cherries are also grown. The state of Michigan leads the other Eastern States in production of sweet cherries, and here about 1 acre of sweet to 10 acres of sour cherries is grown. The sweet cherry most grown in Michigan and in other sections of the East is the Windsor, which is better adapted to clay loam than is any other variety of sweet cherry. The Napoleon and Yellow Spanish varieties, as well as the Magnifique and Montreuil, varieties of the dukes group, are also grown. The principal sour cherries grown in the Eastern States are Montmorency, Early Richmond, Ostheim, English Morello, and Wragg.

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about

CHERRY NURSERY STOCK

12. Propagation of Cherry Trees.—The usual method of propagating cherries is by budding. Seedlings 1 year old are planted and are budded the following summer as soon as buds are ripe on the parent, which is sometime in August in the Northeastern States, and somewhat earlier in sections having a warmer climate. Two kinds of stock are used for propagating cherries, the mazzard, a seedling sweet cherry, and the mahaleb, a seedling sour cherry. Trees grown on mahaleb stock are more dwarf in habit and are said to be more hardy in the West than are trees grown on mazzard stock. For some years the Eastern nurserymen have been budding both sour and sweet cherries on the mahaleb, but there is now a demand for the sweet cherries on mazzard roots to be planted on light soils, and some experiments in New York seem to indicate that even on fairly heavy soils the mazzard is the better root for sour cherries, but even in that locality the mazzard stock sometimes suffers severely during hard winters.

13. Nursery Trees.—It is best to order 1-year-old cherry trees for planting as trees of this age may be headed as low as

desired. They will also have a greater proportion of their roots remaining upon them than will trees which have been



FIG. 5

allowed to grow longer in the nursery. Another advantage of 1-year-old trees is that being small they are much easier to handle and less expensive to ship. In preparing the trees for

planting the same precautions should be observed as in the case of plums.

A No. 1 grade 2-year-old sour cherry tree of the Montmorency variety is shown in Fig. 5 (*a*); it measured 5 feet 6 inches above the bud and 9 inches below the bud, and calipered $\frac{7}{8}$ inch. A No. 1 grade sweet cherry tree of the Napoleon variety is shown in (*b*); it measured 6 feet 3 inches above the bud and 9 inches below the bud, and calipered $1\frac{1}{16}$ inches.

PLANTING OF CHERRIES

14. Methods of Planting.—The methods of planting cherry trees are the same as those already outlined for other fruit trees, with the possible exception that when cherry trees are planted in the cold parts of the Prairie States and north of the 41st parallel, it is deemed to be good practice to plant them 6 to 12 inches deeper than they stood in the nursery row, and this is of special importance on the high, rolling land that is the most suitable for cherry orchards. As a rule, it is wise in any section to plant cherry trees somewhat deeper than they stood in the nursery.

15. Time of Planting.—A large proportion of cherry trees are dug in the fall, and since a great many plantings are made in the fall, nurserymen, to rush the work, strip the foliage, frequently three or four weeks before it would fall naturally; this tends to weaken the trees and increase the loss, which is usually charged to autumn planting. In the judgment of some experienced growers, fall planting, made just as soon as the leaves drop naturally, is preferable to spring planting, as trees well planted in the fall are generally in better condition than trees in the nursery cellar.

The advantages of fall planting are that a better callus of the injured surface of the root is secured and some roots develop before winter. The soil being warmer in October than at any other time of the year, the growth of roots is encouraged more at that time than in spring. When trees are spring planted, the growth of foliage is made largely at the expense of the food

stored in the trunk, and it is some time before the roots can develop marked activity. In fact, it is frequently June before new growth can be seen on the roots. If spring planting is practiced, it should be done as early as possible.

16. Distance for Planting.—Sour cherries are set as close as 10 feet or 12 feet apart; 18 feet by 18 feet is a common distance. The sour varieties would be better planted 20 feet by 20 feet, and sweet cherries should be planted 30 feet apart each way, for in favorable locations the sweet cherry will make a large tree 40 to 50 feet high.

ORCHARD OPERATIONS

17. Cultivation.—The soil for cherries is prepared in the same way as that for plums. A cultivated crop, such as corn, potatoes, beans, etc., or garden truck, is frequently grown between the trees for the first 3 or 4 years, if the soil is sufficiently rich. If intercropping is not practiced and the land is entirely given up to the trees, shallow cultivation is maintained until the middle of July or thereabouts. At this time cultivation ceases and a cover crop of some kind, for example, Crimson clover, oats and barley, buckwheat and rape, or one of various other crops is planted. The important point is to have a good mat of material on the ground to hold snow and afford protection to the roots. In addition, these crops have some value as fertilizers. Many successful growers contend that it is absolutely necessary for a successful cherry orchard that it have good cultivation during its early life and that the trees be developed to a good size before bearing. A little more care must be taken in growing sweet cherries than in growing sour cherries. The sour cherry will stand forcing, but the sweet cherry may be made to grow too rapidly, in which case most of its energies will be devoted to the production of wood growth and little to the production of fruit. When the trees come into bearing it is generally advisable to maintain good cultivation in the case of the sour cherries, but in some cases it is profitable to sow clover in the sweet-cherry orchard and let it remain for

two or three seasons, especially if the trees are making much growth. Each grower will have to decide for himself as to the best method to pursue. It is safe to say that on sandy land cultivation should be maintained for both sweet and sour cherries. It is very important that cultivation be started as soon as possible in the spring, in order to retain as much moisture as possible in the soil.

The tillage implements are those usually used in other orchards.

18. Pruning.—Compared with most other trees, the cherry should receive little pruning, especially after the first 2 or 3 years. During the first year just sufficient wood should be removed to give the tree a spreading habit. The head should be started within 18 inches of the ground and according to some of the most successful growers should consist of from three to five main branches with a leader. Low-headed trees are secured by allowing sufficient distance between the trees and by heading in from the first year. It may be necessary to cut back the growth one-half each year until the tree comes into bearing. If this is done there must also be judicious thinning of the shoots, which are induced to grow because of this method of cutting back. After the trees reach bearing age little other pruning than to take out interfering or diseased wood is needed.

19. Fertilizing.—The question of the desirability of fertilizing cherry orchards depends largely on local conditions. In general, however, where Crimson clover or Red clover can be grown as a catch crop and turned under in the spring, there will be little need to apply nitrogenous fertilizers. It is stated by some growers that the application of phosphate fertilizers, especially in the form of acid phosphate, tends to aid the trees in maturing their wood. Some growers recommend the application of 3 pounds of muriate of potash and 15 pounds of acid phosphate per tree, and in some cases the application of from 100 to 250 pounds of muriate of potash and from 300 to 500 pounds of acid phosphate per acre is recommended. From 300 to 400 pounds of muriate of potash and an equal quantity of ground

bone have been applied per acre with good results. Wood ashes, when obtainable, may be applied at the rate of from 50 to 100 bushels per acre in place of the muriate of potash. In each case the nitrogen is to be secured by plowing under leguminous crops. Some growers use a 2-8-10 complete fertilizer at the rate of 400 to 800 pounds per acre.

20. Spraying.—The first spray should be applied to cherries before the buds break and should consist of lime-sulphur of a specific gravity of 1.03, or 32° Baumé diluted 1 to 8. The second spray should be applied just before the fruit buds open and should consist of lime-sulphur of a specific gravity of 1.007, or 32° Baumé diluted 1 to 40, and containing 1½ to 2 pounds of arsenate of lead to 50 gallons of liquid. This spray may be repeated as soon as the fruit sets and may be followed by two or three subsequent sprayings if necessary. Some growers use Bordeaux mixture in place of lime-sulphur for all sprays except the first. Self-boiled lime-sulphur is sometimes used as a fungicide spray after the fruit forms.

21. Renovation of Old Cherry Orchards.—The cherry, especially in the Eastern States, grows to a good size and lives to a great age, some trees being over a hundred years old, but there are few old cherry orchards. There has been no great cherry business, and it is difficult to state how long an orchard will continue to be profitable. One authority states that probably 30 years is the limit of the most profitable age, for after that time the trees are so large that the expense of picking the fruit and taking care of the trees becomes too great. Before renovating an old orchard, an individual should consider these factors and determine whether it would not be better to plant a new orchard. Cherry trees may be expected to bear at 5 years of age and at 10 years to be making handsome returns; and generally it will take 2 or 3 years to get an old orchard into shape even if it can be accomplished at all.

HANDLING OF THE CHERRY CROP

22. Harvesting.—The labor of picking has been a serious problem in cherry growing, as the fruit matures very rapidly and must be quickly removed or it will spoil. For this reason, a grower should not plant a large cherry orchard unless he is sure he can secure pickers at the proper time. The fruit should be harvested in two or three pickings, as it does not ripen uniformly. The pickers should use ladders and should not be allowed to climb around in the trees, as this is liable to injure the bark and also to break the branches. Pickers are usually paid from $\frac{3}{4}$ to 1 cent per pound, although some growers prefer to hire by the day, because of the greater care exercised by the pickers. Fruit for shipping should be picked with the stems on, but at the same time care must be taken not to remove the fruit spur to which the stem is attached. When the fruit is picked for a short haul to a cannery, it is allowed to become more mature than when it is to be shipped. It is also picked without the stems, which is much easier for the picker and less injurious to the tree.

One of the most successful growers in Michigan harvests all of his cherries by spreading sheets under the trees and permitting the pickers to clip the fruit off with scissors and allow it to fall on the sheet, leaving about $\frac{1}{2}$ inch of the stem on the cherry. Fruit picked in this way sells at a higher price than that which has long stems attached. Cherries should be picked while dry. As soon as the fruit is picked it should be placed in the shade or removed to the packing house.

23. Grading and Packing.—The fruit is poured from the picking baskets onto the packing table. If it can be allowed to cool before it is graded it can be handled much better. Grading and packing usually constitute one operation. The fruit should not be shipped in large bulk, as for example in half-bushel packages, as the fruit is easily crushed. Baskets holding not more than 8 or 10 pounds are used. Some growers pack cherries in berry boxes and use the 16-box berry crate as a carrier. Very fancy fruit packed in 1- or 2-pound packages

and shipped in carriers will often bring a much higher price than if put up in larger packages.

When cherries are to be shipped in small boxes, the tops of the boxes are nailed on and the bottoms left off, and the box is packed from the bottom. Cherries are placed in rows on the inside of the top, with the stems all turned into the box. After the inside is covered, forming the facing, the box is filled and the bottom nailed on and the box turned and marked on the faced side. Lace-edged paper is often placed in the box before the fruit is put in. If baskets are used for packing, the fruit is put in and faced on top. For fancy fruit, facing pays. If the fruit is to be sent to the canner it is not graded so closely and is usually shipped in 8-pound baskets without facing.

24. Storing.—Cherries are regarded by cold-storage men as extremely perishable. The way in which the fruit is handled before it is placed in storage has much to do with its keeping. Cherries that have been properly picked and handled and covered with a layer of cotton batting have been kept in good condition for a month at a temperature of 30 degrees, which is the temperature found best for storing cherries.

Cherries as well as plums have been held in storage frozen at a temperature of from 5 to 12 degrees for several months. They must, however, be used immediately on being taken out of storage. Little has been done thus far in holding cherries in storage for commercial purposes.

25. Marketing.—The problem of marketing is similar to that of all other perishable fruits, but by cooperation a number of small growers can dispose of their crops to as good advantage as the large grower can. Generally speaking, Eastern-grown fruit will not stand up quite as well as that grown in California; there is, therefore, more risk in handling. California cherries can be placed on Eastern markets in April when Eastern trees are in bloom and remain in the market until July. The Eastern grower is hardly warranted in going into the business unless he has a near-by market such as a canning factory that will take large quantities of fruit at very short notice. Such a factory constitutes one of the best markets for a large grower.

If the price is determined before the fruit is consigned to the market the grower is not subject to the risk that is taken when fruit is consigned on commission, as the market may be glutted when the fruit arrives. There is a large and insistent demand on the part of canners for white cherries, that is, the sweet, light-colored cherries, and for red cherries, especially the Montmorency. The price ruling during the last few years has been about 5 cents per pound.

CHERRY PESTS AND INJURIES

INSECTS

26. The **black cherry aphid** is an insect that so far as known attacks only the cherry and does serious injury only to the sweet cherry. Both the winged and the wingless forms of this aphid are shining black. The insects assemble in large numbers on the young shoots or limbs near the base, before spreading to the rest of the tree. If careful watch is kept the insects may easily be destroyed while so clustered and thus may be prevented from spreading to other parts of the tree. The presence of the insects is indicated by a large amount of honey dew on the foliage. The infested leaves soon begin to curl and form a protection for the insects. The black cherry aphid should be controlled by the use of contact insecticide sprays, which should be applied before the leaves curl.

27. The **San José scale** and other scale insects that have been discussed in connection with the growing of other fruits sometimes attack cherries. The remedy is the same as already given for these insects. The sour cherry does not suffer as severely from the attack of San José scale as does the sweet cherry.

28. The **plum curculio** sometimes injures cherries. The remedy is to spray with arsenate of lead as described for plums.

29. The **cherry fruit fly** is an insect native to America. The adult insect is a fly slightly smaller than a house fly; it is

black in color and has a yellowish head and legs and three or four white bands across the abdomen. This insect deposits eggs just under the skin of the cherry. The eggs hatch in a few days into little maggots, similar in appearance to the apple maggot; these burrow through the flesh of the cherry, leaving a rotting cavity. When full grown the maggots leave the cherry and pupate just below the surface of the ground, under rubbish, or in the bottom of baskets in which the fruit is packed. Little has been done toward controlling this insect. A similar fly has recently been controlled in South Africa by spraying the foliage with arsenate-of-lead solution sweetened with brown sugar. The sugar attracts the flies, which are killed by the poison. This

remedy is worthy of trial if the cherry fruit fly should become a very serious pest. Early spring plowing will no doubt bury many of the pupas and prevent the flies from emerging. All fruit that falls or that remains on the trees after harvest should be destroyed. Fig. 6 represents the cherry fruit fly.



FIG. 6

FUNGOUS AND CLIMATIC INJURIES

30. The fungous disease known as **black knot** that causes the black, irregular knotty growth on plum trees also attacks cherry trees. The remedy is to cut out and burn the affected branches as soon as they are discovered. Fig. 7 shows cherry branches affected with black knot.

31. **Brown rot** is the most serious fungous disease with which cherry growers have to contend, and some varieties of sweet cherries are especially subject to its attack. Fruit that cracks is especially liable to be attacked. Hot, moist atmospheric conditions, when occurring at the time the fruit is

ripening, are favorable to the spread of this disease. Bordeaux mixture has been used with partial success to control the fungus, but the foliage of the sweet cherry is very susceptible to injury by Bordeaux. Some growers believe that self-boiled lime-sulphur will prove to be an excellent remedy for the disease. Injury from this fungus may be lessened by picking

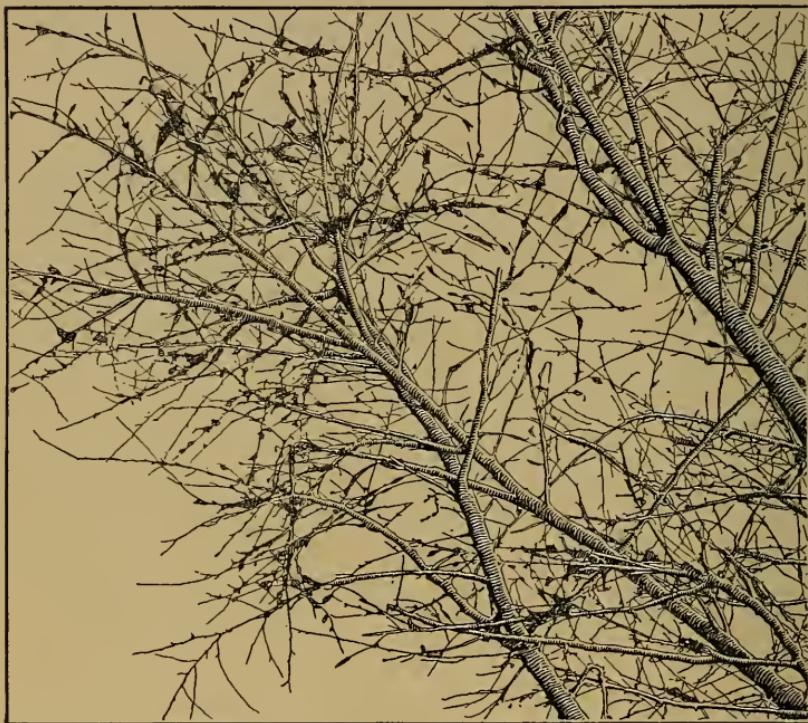


FIG. 7

the fruit before it is fully ripe and when it is perfectly dry. Fig. 8 shows Montmorency cherries affected with brown rot.

32. Powdery mildew sometimes attacks the fruit and leaves of the sour cherry. The description and remedy for this fungus has been given in a previous Section.

33. The shot-hole fungus described in another Section also affects cherries. The remedy is the same as in the case of plums.

34. An injury known as **sun scald** is frequently seen on cherry trees, and especially on sweet cherry trees. This injury is prevalent in the West and South and as far north as Massachusetts. It occurs usually in the late winter or the early spring on the south or the west side of the trunk or of the larger branches. It is caused by alternate freezing and thawing,



FIG. 8

causing contraction and expansion, which bursts the bark on the side of the tree toward the sun. The injury is most prevalent on trees that are growing rapidly. If trees are headed low so that the trunks are shaded there is less danger of this injury occurring. In some of the Western States the trunks are shaded with netting, matting, or a board to prevent this injury.

APRICOTS

35. The apricot tree is a vigorous grower and produces fruit both on the spurs and on the last season's twigs. The fruit ripens in advance of the peach and plum and has the general appearance of the peach, but its pit, which is broad, smooth, and somewhat flat, is more like that of the plum. The earliness of the blooming period of the apricot has been the greatest drawback to its being planted in almost all sections where the peach thrives. In many of the sections where the apricot has been tried, the fruit is nearly always killed by late spring frosts. In many cases the failure of the plants to thrive and to produce fruit has been due to the planting of wrong varieties. With a better knowledge of frost conditions and of methods of protection from frosts, the area over which apricots can be grown has recently increased very rapidly.

The demand for apricots is so great that they will always bring good prices.

The same general statements that have been made in regard to the selection of a location for a peach orchard are applicable to the selection of a location for an apricot orchard. It should be remembered, however, that apricots bloom earlier in the spring than do peaches and, therefore, cannot be grown with as much safety in localities that are subject to late spring frosts as can peaches.

36. Varieties of Apricots.—Brief descriptions of some of the best commercial varieties of apricots are as follows:

The **Moorpark** is one of the latest-ripening varieties. The fruit is large and uniform in size, nearly round in shape, and in color is orange with a deep orange-colored cheek. It is a free-stone and the flesh is bright yellowish orange in color, is firm and juicy, has a rich, high flavor, and the quality is good.

The **Royal** is a leading variety for canning and drying. The fruit is large, roundish in shape, the color is a dull yellow

with an orange cheek and a faint blush, and is a freestone. The flesh is light orange in color, is firm and juicy, has a vinous flavor, and is classed as good in quality.

The **Peach** variety is one of the best. It ripens in mid-season and dries to a deep golden-yellow color. The fruit is very large, has flattened sides, and a well-marked suture, and is of an orange color. The flesh is orange yellow in color, is juicy, rich, and highly flavored.

The **Tilton** variety resembles the Peach variety in respect to size, shape, and time of ripening, but it is more deeply colored. It dries well and is a good canner and shipper.

The fruit of the **Newcastle** variety is of medium size and is valuable for supplying the early market.

The fruit of the **Blenheim** variety is above medium in size and is of an oval shape and an orange color. The flesh is deep yellow in color, juicy, and has a rich flavor. This variety is in great demand for canning and drying.

37. Selection of Nursery Stock.—The apricot may be grown on either peach, apricot, almond, or plum stock. The peach seedling is used most as stock on which to graft apricot scions. The plum should be used as stock for heavy soils, and the peach or the bitter almond should be used as stock for light soils. The almond root should not be used as stock in sections troubled by gophers, as these animals are very fond of it and often destroy large orchards of trees grown on this root.

The pits from which the stock is to be grown are usually obtained at canneries and kept from drying out until the following spring, when they are planted in rows $3\frac{1}{2}$ feet apart, and the pits 3 inches apart in the row and are covered 3 inches deep. The planting can also be done in the fall. The pits may be kept from becoming dry by placing a 2-inch layer of pits in a bottomless box placed on the ground and on top of the pits a 2-inch layer of sand. This operation is repeated until all the pits are covered.

A good nursery tree should be 1 year old and from 4 to 5 feet high. Branches or well-developed buds should be well distributed along the trunk to within 10 inches of the roots.

The trunk, or stem, must be stocky, the roots well developed, and have numerous small branching rootlets. A tree with only a few large roots will start growth very slowly.

Nursery stock should be purchased from well-known nursery firms, and if possible from a nursery located in the district in which the orchard is to be grown.

38. Planting of Apricot Trees.—As soon as the trees are received from the nursery they should be heeled-in until they are to be planted. Apricots are planted from 20 to 30 feet apart. The suggestions in regard to the preparations of the soil for peaches and to the planting of peaches are applicable to apricots.

39. Pruning of Apricot Trees.—The time that elapses between the setting of trees and the time that they begin bearing is the period of formation of the trees and will cover the first 3 years of their existence in the orchard. The first year the tree should be headed back to within 15 inches of the ground, and as the apricot is a very rapid grower there will be many more shoots than are required. As soon as the twigs reach a length of 6 inches all on the stem, from the ground up to a point 8 inches above the surface, should be removed, above this point only five branches should be left and these well placed around the stem. After the trees have become dormant, preferably along toward spring, the remaining branches should be cut back from one-half to two-thirds of their growth and the side shoots on them thinned to from three to five shoots on each branch and each shoot should be cut back to spurs of three buds. This pruning leaves stubs of about $1\frac{1}{2}$ feet in length as a foundation on which to build the tree. The pruning for the next 2 years should be such as to make the tree as stocky as possible. To accomplish this the pruning the second and the third year should be almost as severe as that given the first year. The sprouts on the trunk and all drooping branches should be removed to allow light and air to get into the head of the tree, otherwise the twigs and spurs in the center will be smothered out. All main branches should be cut back about one-half.

From the fourth year good crops of fruit should be expected, and as the habit of the tree is gradually to extend the bearing wood farther and farther away from the trunk and the spurs near the body to break off or die, a rather vigorous heading back must be practiced. Heading back favors new growth on the trunk and on the large branches near the body, thus keeping the fruiting surface more evenly distributed. The extent of the pruning depends on the growth of the trees. A vigorous growth may be cut back one-half and a light growth one-third, but the branches should be kept thinned and cut back so that the sunshine can get to the center of the head to ripen and color the fruit.

40. Renovating Apricot Orchards.—The first step in renovating an old orchard is to give the land a thorough plowing, preferably during the fall. The orchard should then receive a thorough pruning. All suckers from around the base of the trees and all broken and diseased branches should be removed and the head cut back very severely. If the orchard has not been pruned for some years, at least one-half the length of all branches should be removed. The orchard should then be sprayed thoroughly with lime-sulphur, 1 gallon of stock solution of 30° Baumé test to 7 gallons of water, making a spray of a specific gravity of about 1.03.

41. Fertilizing.—The most common fertilizers in use for apricot orchards are dried blood, bone meal, nitrate of soda, muriate of potash, and superphosphate.

If the leaves of the trees are of light color and the growth of the trees is poor, the application of from 150 to 200 pounds of nitrate of soda per acre sown broadcast and cultivated under will have a beneficial effect. If the fruit is not up to standard as to flavor and texture, an application of from 400 to 500 pounds per acre of a mixture consisting of 1 part of acid phosphate, or superphosphate, and $2\frac{1}{2}$ parts of muriate of potash will be beneficial.

If a complete fertilizer is desired about 500 pounds per acre of the following mixture can be used: Nitrate of soda, 150

pounds; muriate of potash, 250 pounds; acid phosphate, or superphosphate, 100 pounds.

A chemical fertilizer should be applied during the spring. Cover crops or green manure are valuable in improving the fertility of orchard soils.

42. Apricot Pests and Injuries.—The apricot tree is one of the healthiest of fruit trees. There are but few insect pests and fungous diseases that seriously injure the tree or its fruit, but the tree is very susceptible to injury from frost. In fact, it is climatic conditions more than anything else that curtails the production of apricots. The principal insect enemies of the apricot are the plum curculio, the peach borer, and the San José scale. The worst disease that affects the apricot is the shot-hole fungus, which causes considerable damage by perforating the leaves with small holes similar to shot holes and by causing numerous small scars on the fruit that materially reduce its value. These pests and injuries are combated by the same methods that have been recommended elsewhere.

43. Harvesting of Apricots.—The stage of maturity at which apricots should be picked depends on whether the fruit is to be shipped, canned, or dried. For shipping or for canning purposes, the fruit should be well colored and ripe, but only ripe enough to be firm; that is, it should not be ripe enough to be in the least soft. Fruit that has begun to soften will not stand shipping and should be dried.

An orchardist should have a good supply of picking buckets of the 12-quart, wide-mouth type, and field boxes, which should be of uniform size and hold about 1 bushel. Good step ladders are a necessary part of a picking equipment. All fruit that is ripe enough to ship should be gathered at one picking. One or two apricots should be picked at a time and laid, not dropped, into the receptacle. A number of apricots should not be held in the hand at one time, as they are very apt to be squeezed and bruised. All the lower fruit should be picked and placed in the boxes and the fruit in the top of the tree picked from the step ladders and placed in the buckets. The

boxes or buckets should not be heaped, as there would be too much weight on the fruit in the bottom of the box or bucket. The fruit should not be emptied out of the boxes or buckets, but taken directly to the packing house and picked out. Every time the fruit is handled its shipping quality is impaired. All the fruit should not be picked at one picking, because it does not all ripen at the same time. The trees should be gone over several times before all the crop is removed.

44. Grading and Packing of Apricots.—Part of the grading can be done as the fruit is being picked by leaving all deformed or diseased specimens in the orchard. The final grading is done by the packers. All soft, broken-skinned, undersized, and otherwise blemished fruit is culled out by the packers as the fruit is sorted according to size and packed.

Apricots are packed in carriers containing four baskets 8 in. \times 8 in. \times 4 in. in size. Paper is used to line the baskets and to place between each layer of fruit. The style of pack that is used depends on the size of the fruit. When it is possible, some form of the diagonal pack, as described for apples, is used. The diagonal pack allows fruit to be so distributed that each fruit bears a part of the pressure and weight of other fruits in the pack. Also, the fruit in diagonal packs suffers less from shipping than it does in other forms of packs, especially the straight pack. However, small fruits are usually placed in straight packs because it is easier to bring the fruit to the top of the basket by using the straight pack than by using the other forms of packs.

45. Marketing of Apricots.—The apricot is one of the most perishable of tree fruits, the season for it in the fresh state ending almost with the last picking. As a result, the larger number of apricot consumers are more familiar with the canned or dried product than they are with the fresh. Shippers realize that the only limit to the consumption of the fresh fruit is its keeping qualities, and that anything that will lengthen its season will also increase the profits. At present careful attention is being given to precooling and to shipping the fruit in refrigerator cars. It has been found that by cooling the

fruit before loading and then carefully icing the cars, apricots can be put on all the large markets in America in carload lots and then distributed from there to the near-by small towns. If the shipper has access to a good cold-storage plant at the receiving station, the shipment can be unloaded right into the storage room. This will give him a chance to hold his fruit for a better market.

Some of the most difficult problems that are found in the marketing of the apricot is to get the grower educated to pick and to pack his crop properly. A poor shipment is nearly always due to the fruit being roughly handled, to having stood in the sun after it was removed from the trees, to having been packed in a dirty packing house, or to poor packing.

46. Drying of Apricots.—At the present time the bulk of apricot drying is done in the sun on a small plot of ground set aside for the purpose. When the drying season approaches, the drying yard is cleaned up and the trash removed. The fruit is allowed to get riper than that used for shipping. In many orchards the fruit is shaken off of the trees. However, it is a much better plan to pick the fruit. The fruit is taken to a shed where it is cut, never torn, in half and the pit shaken out. The halves are spread, skin side down, on a tray and subjected to the fumes of burning sulphur, from $\frac{1}{2}$ an hour to 2 hours, depending on the condition of the fruit. This is done in order to make the fruit dry to a light amber color. The length of time in the sulphur box required to give this color can be learned only by experience. The trays containing the fruit are then placed in the sunshine for from 3 to 6 days, the exact time necessary to dry the fruit completely varying with the climatic conditions and also with the condition of the fruit. A few apricot growers dry their fruit in evaporators. About 6 pounds of green fruit will make 1 pound of dried fruit.

QUINCES

INTRODUCTION

47. The quince is grown commercially less extensively than any of the other tree or bush fruits, and although a comparatively limited quantity of this fruit is offered for sale, experience proves that when a grove is rightly taken care of it can be made very profitable. One of the best examples of the truth of this statement is the history of a neglected quince grove of $\frac{1}{4}$ acre in New York State. The trees were about 30 years old and had been practically abandoned. No fruit had been secured for 4 or 5 years, but it was thought by the owner that the trees were worthy of renovation. Accordingly he pruned out the dead wood, cultivated the land, and sprayed the trees. The first year after the renovation no fruit was grown, but the succeeding years showed good results, the returns for the next 6 years being as follows: \$112.50, \$119, \$150, \$138.20, \$138.75, \$185.25. When it is remembered that these returns were from $\frac{1}{4}$ acre of trees that had been neglected for 30 years, they seem surprisingly large.

Quince trees generally begin to bear a small quantity of fruit the third or the fourth year after being planted. They should be in full bearing in 10 years after being planted, when an annual yield of a bushel to a tree can be expected. The life of a tree after coming into bearing averages from 30 to 40 years.

The demand for quinces would undoubtedly increase were more fruit of good quality offered for sale. Quinces are very acceptable for canning, evaporating, and the making of jelly, marmalade, and preserves, and when boiled and served hot with cream or butter they are an excellent dessert; another use is to bake them with Pound Sweet apples to be served as baked apple and quince. The Chicago market will take a large

quantity of fruit for this last-named purpose; in fact, they are used to such an extent for this purpose that the supply of quinces has an influence on the price of Pound Sweet apples. The price of apples of this variety is likely to be low, if but few quinces are offered on the market.

Among the points that can be given in favor of growing quinces commercially are: (1) The trees are almost sure to bear regularly if they have the proper care; (2) as the trees are small, seldom averaging over 15 feet in height, they are easily sprayed and pruned, and the fruit is easily thinned and harvested; (3) quinces are late bloomers, usually not coming into blossom until all danger of frost has passed; (4) the fruit is not very perishable, being about like apples in this respect; (5) the prices received for first-class fruit have in the past been large, and it is to be expected that, even with a marked increase in acreage, the prices will continue to be large, as there would be a tendency to increase the consumption if enough quinces were offered for sale to let consumers learn of the many good qualities of this excellent fruit.

IMPORTANT VARIETIES OF QUINCES

48. Descriptions of some of the important varieties of quinces suitable for planting in the United States and Canada are given below. Several other varieties are sold by nurserymen, but those described are the most important ones for both home and commercial planting.

The **Orange**, or as it is also known, the *Apple* quince, one of which is illustrated in Fig. 9, is probably the most important commercial variety. The tree is a moderately vigorous grower and has wide, spreading branches. The fruit is variable in size and shape and may be pear shaped or be flattened on the end like an apple. The color of the fruit is a pale orange and the surface is moderately covered with down. The flesh is very firm and of a good flavor. When grown under the most favorable conditions, the fruit of this variety can be kept until February. It ripens about mid-season.

The **Champion** is an American variety of quince of rather recent origin. The tree is an upright grower and usually attains a somewhat greater height than trees of the Orange variety. The fruit is large and pear shaped and is furrowed about the stem. The color is generally a greenish yellow, and the fruit is covered with a prominent fuzz. The quinces are late in matur-

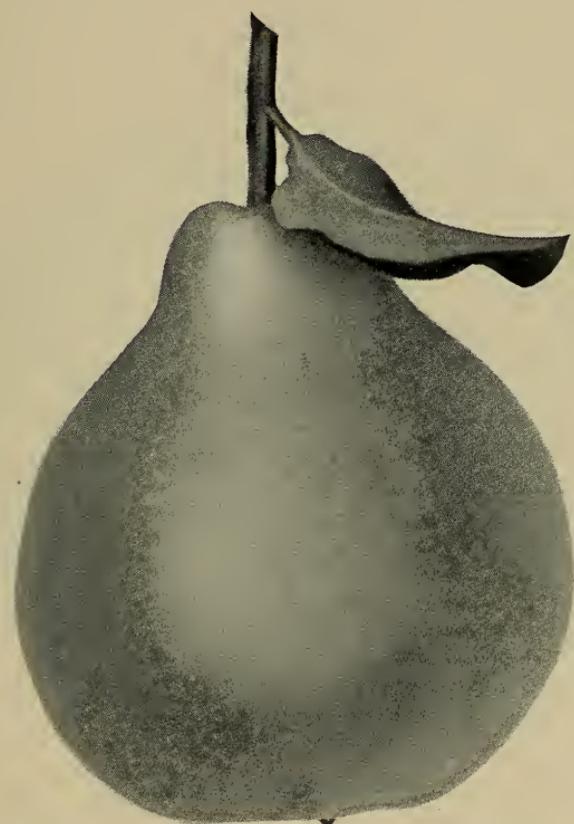


FIG. 9

ing and in some sections do not ripen well, but when grown under good conditions the fruit is said to be one of the best keepers.

The fruit of the **Rea**, is from a third to a half larger than the fruit of the Orange variety. The tree is small, as a rule, only about two-thirds the size of trees of the Orange.

The fruit is large to very large. The color is orange and the surface is generally smooth, lacking the pronounced fuzz of the varieties previously described. The fruit is of good quality and ripens early but does not keep as well as fruit of the Orange.

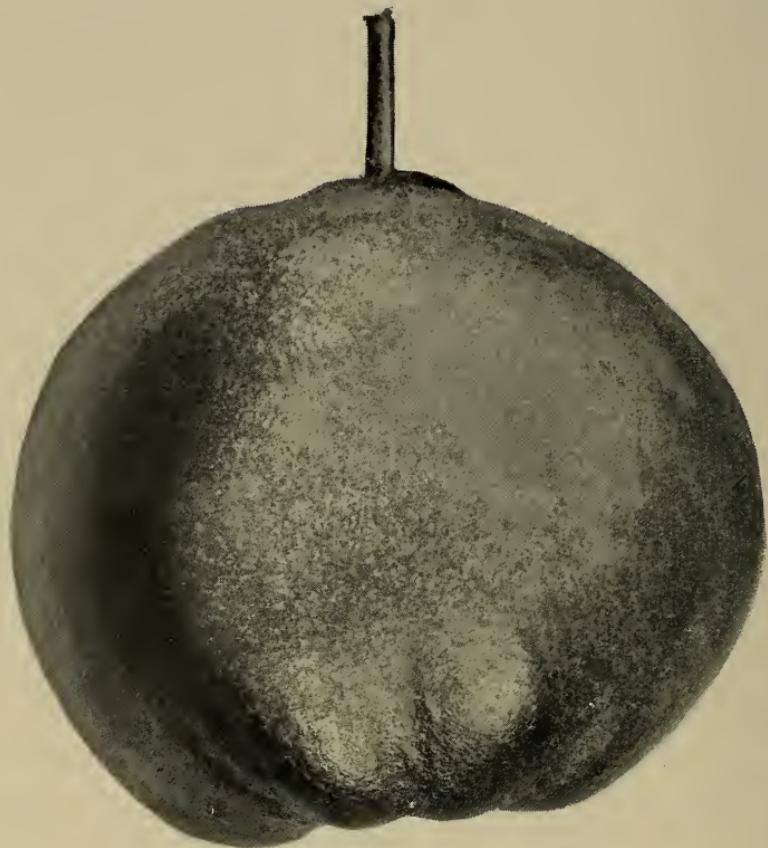


FIG. 10

The trees need good cultivation for the best success. A quince of this variety is illustrated in Fig. 10.

The tree of the **Meech**, also known as the *Meech Prolific*, variety of quince is something like that of the Orange variety. The trees have the spreading habit well developed. They bear young and are usually good croppers. The fruit is of good appearance but is inclined to be small, and largely for this reason it is not as valuable for market purposes as the fruit

of some of the other varieties. In some sections it is claimed to be one of the most productive of varieties, but in other sections this claim has not been borne out.

The **Missouri**, or *Missouri Mammoth*, is a variety of quince that is generally regarded as being very prolific. The tree is large, in fact, the largest of any of the varieties of quinces

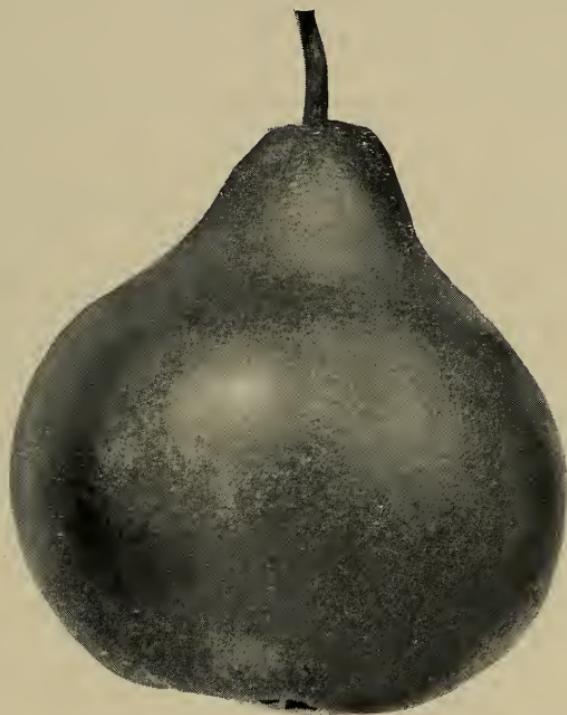


FIG. 11

described. The trees bear reasonably young, and, as a rule, give fair crops. The fruit is of fair size and is rich and aromatic.

The **Bourgeat** is a variety of quince that can be held in storage until spring. The tree is a strong grower and is regarded as being a very good bearer. The fruit is large in size, of a bright yellow color, and has a very small core; its keeping quality is of the best.

The **Van Deman** variety of quince is a recent introduction of Luther Burbank, of California, and by some it is claimed to

be one of the hardest and surest bearers in existence. The fruit ripens throughout a comparatively long season, and it is claimed to have excellent keeping qualities.

The **Pear** variety of quince, illustrated in Fig. 11, is grown to a limited extent in quince-producing regions. The trees are of average size and are considered to be moderate bearers. The fruit ranges from medium to large in size; the skin is a dull reddish yellow, covering a firm, tough, and rather dry flesh. The flavor is good but slightly inferior to that of the **Orange** variety. The fruit ripens late and has excellent shipping qualities.

QUINCE-ORCHARD ESTABLISHMENT

49. Selection of Location.—In selecting a location for the establishment of a quince orchard, about the same factors should be considered as with any of the other tree fruits, except that, on account of the late blooming habit of the trees, a location somewhat more subject to early spring frosts, may be chosen if desired.

The best type of soil for quinces is generally conceded to be a clay loam that is fairly retentive of moisture, but one that is well drained. On very light soils the trees grow quickly, but they are short lived and usually unproductive.

50. Selection of Varieties.—Although but few varieties of quinces are found in cultivation, in establishing a grove it is generally a good plan to plant several varieties that mature at different times during the season, in order that the fruit may be had in succession. As with other fruits, it is well to ascertain, if possible, from growers in the vicinity which varieties do best in the locality where the trees are to be planted.

51. Propagation of Quinces.—The quince can be propagated in one of four ways: (1) By budding, (2) by mound layering, (3) by root grafting, and (4) by cuttings. The budding method is the one most often employed by nurserymen. Seedlings of a variety known as **Angers** which are imported from France, are used as stocks, and after budded they are trained either in a tree or a bush form, according to

the ideas of the nurseryman. If they are received from the nursery as bushes, the head being formed within 6 or 7 inches of the ground, the orchardist can form a permanent head at whatever height he desires. If, on the other hand, the nurseryman trains the young plant in the tree form, the head will be formed when the grower receives the trees, and he will have no opportunity to form the head according to his own desires.

When quinces are propagated by mound layering an old plant is cut back to encourage a growth of sprouts, and when these are well started a mound of soil is thrown over the crown. After the sprouts have taken root they are detached and sold as young quince plants. A disadvantage of mound-layered plants is their tendency to form numerous sprouts after being planted.

In root grafting, the quince scions are grafted on apple-tree roots. After being allowed to grow for a year the roots are dug and if the quince scions have formed roots the apple roots are removed and the young quince replanted.

Nurserymen who have light soils sometimes propagate the quince by hardwood cuttings. These cuttings are placed in the soil and after they take root are transplanted.

52. Purchasing of Young Quince Trees.—When purchasing young quince trees, it is important that a grower visit the nursery and select the trees himself. He should aim to get thrifty, vigorous specimens, preferably those not older than 2 years from the time of budding. They should be headed low, not more than 10 inches from the ground. Too often purchasers try to get as large a tree as they can for a given price. This is a mistake, for such trees are usually headed too high, and they are likely to be 3 or 4 years old and to be culls from previous years. The young trees should be examined carefully for borers, and any that show signs of injury from this insect should be discarded. Trees showing evidence of fire blight should also be discarded, for they will not only be practically worthless themselves but will carry infection to other trees.

The purchaser should guard against getting seedling trees—that is, those on which the buds of the cultivated variety did

not take. Often as high as 30 or 40 per cent. of the buds fail to grow, and unless the young trees are carefully examined a large percentage are very likely to be seedlings. With a little practice, however, it is not difficult to tell the seedlings from the cultivated varieties, for the distance between the buds on the twigs of the seedlings is usually much less than in the case of cultivated varieties. In view of the fact that there is such a likelihood of getting seedling stock, it will pay the grower, when purchasing quince trees, to deal with a reliable nurseryman, one from whom redress can be secured if the trees prove to be untrue to name.

53. Planting of Quince Trees.—Quince trees may be planted either in the spring or the fall, but probably the majority of growers prefer spring planting. When planting in the spring, it is advantageous to get the trees from a near-by nursery so that they can be placed in the ground a day or so after being dug, preferably the next day. Experience shows that trees planted soon after being taken from the nursery make a much more satisfactory growth than those dug the fall previous and stored during the winter. With fall-planted trees it is also an advantage if the trees are planted soon after being taken from the nursery row.

When the quince is planted soon after being taken from the nursery row and if it has a good head started within a few inches of the ground, all the pruning necessary at the time of planting is to remove any excess of limbs, not even cutting back the terminal. However, if the tree has become dried in shipment and the tips of the limbs are dead, all such parts should be pruned off.

The preparation of the soil, the laying out of the grove, and the setting of the trees are the same for the quince as for other tree fruits. It is especially important in the case of quince trees, however, that the soil be tamped well about the roots. For commercial planting, quince trees should be placed about 15 feet apart each way. The trees will then have sufficient room in which to develop a low, spreading head. Too close planting is as unadvisable as for other kinds of fruit trees.

MANAGEMENT OF QUINCE ORCHARD

54. Pruning.—The question of how much or how little to prune quince trees is one on which growers do not agree. Some prune their trees severely, as much as one-half of the new growth each year, but such men are usually those who force the trees with nitrogenous fertilizers, and who must therefore prune severely to keep the trees within bounds. Other growers allow the trees practically to grow at will from the time they are planted until they come into bearing, pruning only enough to keep the fire blight in subjection and to keep them headed back slightly. Most growers agree, however, that after the trees come into bearing, some annual heading in and cutting back of fruit-bearing branches is desirable in order to improve the size of the fruit. This cutting back of fruit-bearing wood has the same effect as thinning, for the quince, like the peach, bears fruit on wood of the previous year's growth. Pruning should not be so excessive, however, as to cause a large growth of tender sprouts, for such growth is subject to attacks of fire blight.

55. Spraying.—As with other fruits, combined fungicidal and insecticidal sprays are used for quince trees. Following is a system that is in use by several successful growers:

1. Just before the blossoms open, spray with Bordeaux mixture (6 pounds of copper sulphate, 6 pounds of lime, water slaked, 50 gallons of water); Bordeaux mixture appears to be well adapted to the requirements of the quince. Arsenate of lead (2 or 3 pounds of arsenate of lead to 50 gallons of fungicide solution) should also be used with the fungicide spray at this time. This spraying is for the control of leaf and fruit spot or black spot, rust, and curculio.

2. Immediately after the blossoms have fallen, or even while the last of the petals are falling, spray with Bordeaux mixture (3 pounds of copper sulphate, 4 pounds of lime, water slaked, 50 gallons of water) and arsenate of lead ($2\frac{1}{2}$ or 3 pounds of arsenate of lead to 50 gallons of spray solution). This spraying is for the control of the same troubles mentioned in paragraph 1.

3. From three to four other sprayings at intervals of 10 days after the spraying described in paragraph 2 will be sufficient to keep the fruit and foliage in excellent condition.

56. Cultivating and Cover Cropping.—A quince grove should be kept well cultivated until some time in July, when a cover crop should be sown, and as the quince is comparatively shallow rooted, cultivation should be shallow. The kind of cover crop to use will depend largely on the richness of the soil. If the soil is deficient in nitrogen, a leguminous crop should be sown, but if the trees seem thrifty and not in need of new wood growth, some non-leguminous crop should be used. The non-legumes recommended as cover crops for plum and cherry orchards are applicable for quince groves.

57. Intercropping of a Quince Orchard.—While the quince orchard is young, beans or some other cultivated crop may be grown between the trees, but owing to the short distance between trees there is usually little profit in the extra crop. The better plan seems to be to keep all the space between the trees well cultivated until the cover crop is sown in July.

58. Fertilizers for Quince Groves.—In many of the best commercial quince groves, barnyard manure is applied each year, enough being used to keep the trees in good but not excessive growth. In other orchards, commercial fertilizer containing phosphoric acid and potash is used, the nitrogen supply coming from leguminous cover crops. The quantities that have been used by some successful growers in New York State are from 300 to 500 pounds of acid phosphate and from 200 to 300 pounds of muriate of potash per acre. Other growers use from 200 to 400 pounds of ground bone and from 200 to 300 pounds of muriate of potash per acre. If a complete mixed fertilizer is desired, it should analyze 2 per cent. nitrogen, 8 per cent. phosphoric acid, and 10 per cent. potash. From 400 to 800 pounds per acre is the usual range of application. An excessive wood growth should not be encouraged for quince trees, and for this reason fertilizers excessively rich in nitrogen should be used sparingly, if at all.

59. Treatment of Winter-Killed Quince Trees.—Frequently young quince trees, and sometimes mature trees, are injured by winter killing. If the lower part of winter-injured trees is covered with snow there is likely to be life left below the snow level. In such a case, if the top is removed before growth starts in the spring, the tree may form a new head. The dead parts should be removed early in March so that growth can start early.

60. Protecting Quince Trees From Mice.—Mice frequently injure the trunks of young quince trees, and to guard against them it is well to provide the trees with wire guards, especially during the winter months. Painting the trunk with white paint is often advised for this trouble, but it is less effective than the use of wire guards.

HARVESTING AND MARKETING OF QUINCES

61. The quince is ready for harvesting as soon as the fruit has turned a good color. Picking is done in the same manner as for apples. Great care should be taken not to bruise the fruit, because each bruise soon becomes a dark-brown spot that detracts greatly from the appearance of the product.

The fruit should be carefully graded, and at the time grading is done each quince should be wiped with a cloth to remove the fuzz adhering to the surface. The removal of this fuzz causes the fruit to have a better appearance than otherwise. Most growers make three grades of quinces, besides the culls. Each grower generally has his own standard of grading, but as a rule the first-grade fruit will consist of quinces of the largest size and best color. That placed in the second grade will be somewhat smaller in size, and some of the quinces may be slightly off color. The third-class fruit will be made up of small sized but sound fruit and some poorly colored specimens of fair size.

The first and second grades are usually packed in small containers, the very best often being placed in peck-size climax

baskets, and the second grade in kegs holding about a bushel, or sometimes in half barrels. The third-grade fruit is usually packed in standard apple barrels.

Quinces are not often held in storage, as there is generally a sufficient demand in the fall to induce growers to sell at that season of the year. The fruit can be kept in cellar storage as late as January or February. The temperature recommended for quinces in cold storage is 35° F.

The problems involved in the marketing of apples are applicable also to quinces. The demand is, as a rule, very good, and growers have practically no difficulty in disposing of their crops. When possible to do so, it seems that the retailing of quinces locally is a good method of marketing. A small package can be used, and consumers will soon learn of the merits of the fruit and buy accordingly.

QUINCE PESTS AND INJURIES

62. The quince is subject to attack by the San José scale, the codling moth, borers, and the quince curculio.

Although the San José scale attacks quince trees, it does them but little harm, as the trees seem able to withstand the effects of this insect without appreciable injury. However, since the scale can be spread from one species of plant to another, it is sometimes well to spray dormant quince trees with lime-sulphur solution in order to prevent the scale from spreading.

63. The **codling moth** injures the quince in the same manner that it injures the apple and pear, and can be controlled in the same way—that is, by spraying with an arsenical poison.

64. The **round-headed apple-tree borer** causes considerable injury to quince trees unless precautions are taken to remove the insects, which are found from a point about 2 or 3 inches below the ground level to 1 or 2 feet above the ground. They excavate burrows in the trunk and crown and can be destroyed by digging into the burrows with a sharp knife or wire,

after which the wounds should be disinfected with mercuric-chloride solution of a strength of 1 to 1,000, and if a serious wound has been made it should be covered with grafting wax.

65. The **quince curculio** is a snout beetle somewhat larger than the plum curculio, and is broader shouldered and has a longer snout. Two views of this beetle are shown in Fig. 12. The size is indicated by the vertical line. The beetles are ashy gray in color, mottled with ocher yellow and white. On the wing covers are seven narrow longitudinal elevations with two rows of dots between each. The beetles appear some time during June, when they puncture the immature fruit, making cylindrical holes in which they deposit their eggs. The eggs hatch in a few days and the larvae make burrows into the fruit near the surface, not penetrating the core. In about a month the larvae become full grown and leave the fruit and bury themselves in the ground, where they remain until May, when they pupate. In a few days the beetles appear and soon begin to puncture the fruit and deposit their eggs. This insect is combated by spraying the foliage with an arsenical poison, sometimes by jarring the trees as described for plums, and also by collecting the fruit that falls prematurely to the ground.

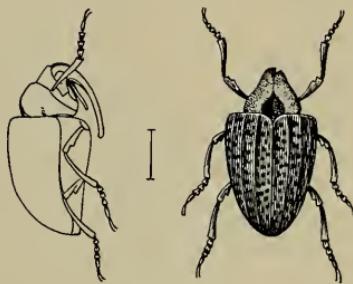


FIG. 12

66. The **bag worm**, known also as the *basket worm*, described previously as affecting apples, also attacks the quince. It can be combated by gathering and destroying, during the winter, the cases that contain the eggs for the next brood.

67. Among the most destructive diseases affecting the quince are fire blight, or pear blight; fruit spot, or leaf blight; rust; black rot; ripe rot; pale rot; and quince rust.

68. **Fire blight**, or *pear blight*, is the most destructive disease of the quince, and as in the case of the pear can be combated

only by preventing infection and by destroying infected parts. The grove should be gone over once or even twice a week during the growing season; every leaf and twig that shows infection should be removed and the cut surfaces disinfected with a solution of mercuric chloride of a strength of 1 to 1,000. This solution may be applied with a swab. It is advisable to cut off the limb about 8 to 10 inches below the



FIG. 13

point of apparent infection. All parts removed from the trees must be taken from the orchard and burned to prevent further infection of the trees. Any trees growing wild in the vicinity that show evidence of the blight should be removed and burned. The wild haw is very likely to carry this disease.

69. Fruit spot, or *leaf blight*, affects both the leaves and the fruit of the quince. The leaves become spotted and drop

prematurely, causing the tree to lose vigor and vitality. The fruit becomes covered with small brownish spots that gradually increase in size and turn black. Fig. 13 shows quinces affected with fruit spot. The disease is controlled by spraying with Bordeaux mixture or lime-sulphur. The first spraying should



FIG. 14

be made just before the blossoms open, and the second soon after they fall. Two more sprayings at intervals of 10 days or 2 weeks will be found beneficial.

70. Black rot and ripe rot are similar to these diseases of the apple, and are combated in the same manner as for the apple. The same treatment is also effective for **pale rot**, which is often a very destructive disease of the quince. This rot begins as a pale almost colorless soft spot on the skin of the fruit. The spot soon wrinkles and turns a pale blue and

the skin becomes ruptured. The disease spreads rapidly and soon destroys the fruit.

71. The disease known as **quince rust** is similar to apple rust, and, like the latter, comes from adjacent cedar trees and produces swellings or the so-called cedar apples. The trouble affects both the fruit and the leaves of the quince. Fig. 14 illustrates the effects of the quince rust. The remedy for the trouble is to remove, if possible, all cedar trees from the neighborhood of the grove. Another method of control is to spray the affected trees with Bordeaux mixture or with one of the sulphur compounds at the time the gelatinous horns are present on the cedar apples.

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NOTE.—All items in this index refer first to the section (see the Preface) and then to the page of the section. Thus, "Anjou pear, §8, p21," means that Anjou pear will be found on page 21 of section 8.

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